Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXI. OCTOBER, 1921 No. 4

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It is probable that articles so produced will be of value to others than the ones requesting their publication.

Tell us about it and we will do the rest.

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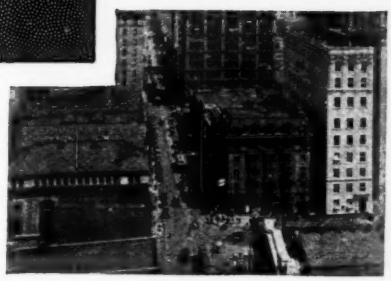
BALTIMORE AND TEXACO



Baltimore Street, the main thoroughfare in Baltimore, paved in 1914 with TEXACO Sheet Asphalt. Photo taken August, 1921.

Baltimore this month acts as host to the members of the American Society for Municipal Improvements.

Suitable, indeed, is Baltimore as a meeting place for such a body of experts, for no other American city has accomplished more in harbor expansion, industrial and commercial growth, park and residential development, and general municipal improvements.

Eutaw Street, in Baltimore's shopping district, paved in 1912 with TEXACO Sheet Asshalt. Photo taken August, 1921.

As Baltimore proudly receives the A. S. M. I., so The Texas Company in the same spirit welcomes the opportunity of showing America's leading engineers the excellent TEXACO Asphalt pavements in Baltimore, of which pavements R. Keith Compton, President of the A. S. M. I. and engineer of the city's paving commission, writes:

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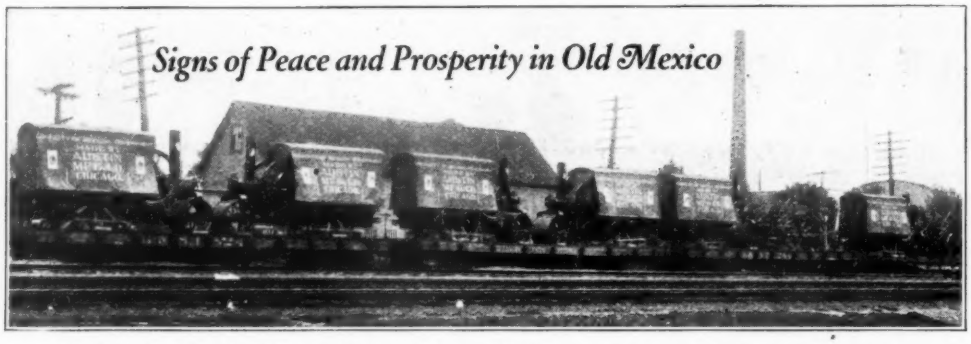

Trainload of Austin Motor Rollers and Road Machinery sold to the Mexican Government

To be used successfully in the out-of-the-way corners of the world, road building equipment must be absolutely dependable; first, last and all the time.

Austin-Western machinery can be found in most of these corners, giving the same lasting service and satisfaction that distinguish it at home.

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For Sale at an attractive price, an Iroquois 2-unit portable asphalt plant; 3,000-gallon steam heated kettle; rated capacity, 800 yards, but has done 1,000 yards per day. Practically new; has done only one job of about 40,000 yards. The price should be very attractive to any contractor or city in the market for an asphalt plant.

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702 Wulsin Building Indianapolis, Indiana

A Real Test of Kentucky Rock Asphalt

When the Nelson Avenue Experimental Road at Columbus, Ohio, was constructed in 1909, a small quantity of Kentucky Rock Asphalt was left along the roadside. There, in its loose state, this material was subject to the action of the weather and decaying vegetation.

Every engineer knows that absolute disuse is the most severe test of asphalt. It will retain its life much longer under the action of traffic.

Yet, in August, 1921, twelve years after it had been dumped along the road, this Kentucky Rock Asphalt was used in making a patch on the adjacent surface, as shown in illustration.

Kentucky Rock Asphalt is a natural asphalt mix, which does not lose its life. It can be stored in the open for an indefinite time without injury from rain, snow or frost.

Kentucky Rock Asphalt does not crack, roll, buckle or bleed. Cut the road surface today and tomorrow it will be healed under the traffic. This means a perfect water-proof cover for the road base, so essential to the life of the highway.

Let our engineering department help you solve your construction and maintenance problems. Write for Booklet E.

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Old material from road side was placed in a hole dug in the asphalt surface of the road. The Kentucky Rock Asphalt was then tamped with the foot.

The old asphalt bonded with the surface, making a perfect patch.

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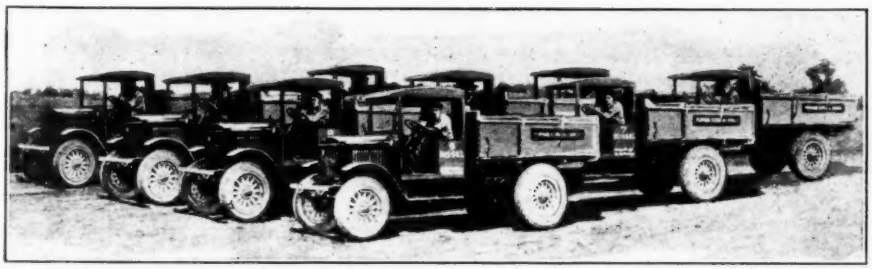
MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



FLEET OF 9 SPECIAL KISSEL ROAD-BUILDERS5 TRUCKS EMPLOYED BY PEPPARD, BURRILL & CONNELL, ON JOHNSON CREEK, WIS., ROAD CONTRACT.

Motor Truck Operation and Accounting—74

MOTORIZED REFUSE COLLECTION AT PEORIA, ILL.

By E. E. Pierson, Bloomington, Ill.

By the utilization of a system of motor trucks and trailers the operating expenses of the Peoria, Illinois, garbage department have been greatly reduced, while efficiency has been promoted.

Perhaps the most perplexing problem that confronts the American city of any size is the disposition of the municipal waste. Refuse from the kitchen, ashes from the stove and furnace, paper, etc., accumulate and must be disposed of. Each city, in most instances, experiments in a number of varying directions and widely divergent methods in the hope of keeping the expense to the lowest possible point and, at the same time, safeguarding the public health and eliminating complaints from householders, business institutions, etc.

TRUCK AND TRAILER TRAIN HAULING MUNICIPAL REFUSE IN PEORIA, ILL.

The Peoria system saves much lost motion by the use of heavy trucks and a long string of trailers coupled together. Smaller trucks bring in one trailer to the headquarters of the garbage department, one truck and trailer being assigned to each district. Heavier trucks then haul four to six of the loaded trailers to the city dump, low places which are to be filled with the refuse, or to the yards of stockmen who feed the edible portion of the garbage to hogs.

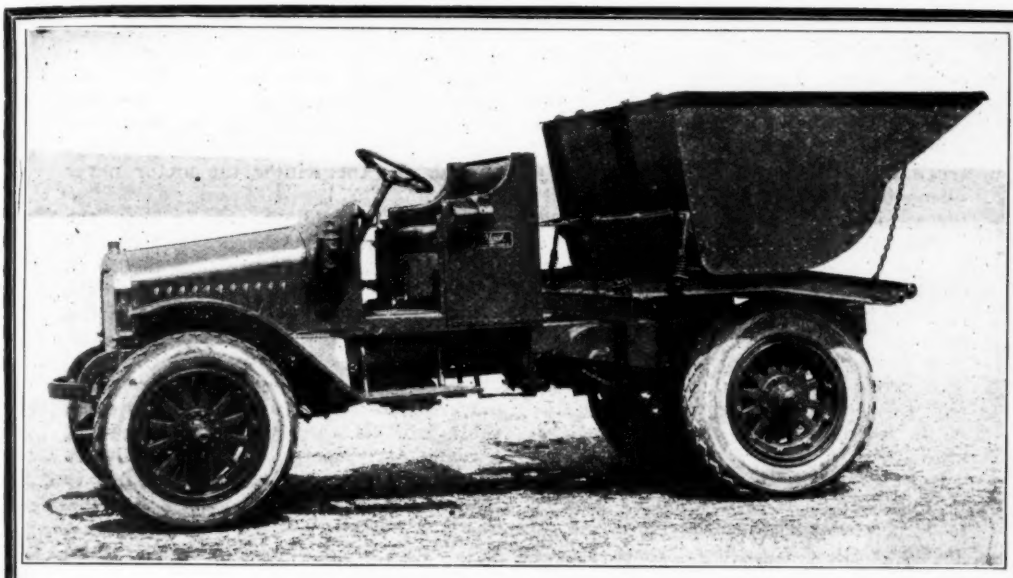
The expenses of the garbage department have been vastly curtailed since trucks and trailers were adopted, while complaints from the public have been greatly reduced. The present method of garbage disposal is the most satisfactory and most efficient in the history of the city.

TWO TON TRUCK SAVES $4,000 PER YEAR ON ASH COLLECTION WORK

By Charles E. Firth, Box 27, Crum Lynne, Pa.

The dependability of my 2-ton Acme truck is shown by the fact that it has never been laid up for a day. Since October, 1920, it has been operating chiefly on ash collection work for the city of Chester, Pa. This work is done under contracts secured in competitive bidding. As the bids must be figured on a very close margin of profit, a dependable truck is essential.

The truck has been running on this work 5 days a week. In the morning it makes a 2-mile run to Chester, starting in on its ash collection work as soon as it reaches the city. The truck operates with 2 helpers, who go along beside it, picking up the boxes and baskets of ashes and dumping them into the truck. We always try to get the main streets cleaned before the big business rush commences, in order to avoid congestion caused by park-



A Special Mack Road Building Truck

THIS piece of modern road-building equipment is designed primarily to make possible the rapid handling of materials. This phase of present-day highway construction can be and often is the deciding factor in the matter of profits.

This Mack Road Building Truck is adapted to carry dry aggregate in batches from the central storage plant to the mixer on the road. It can be used equally as well in transporting wet mix from the central mixing plant to the job.

Detailed description and specifications of the Mack Road Building Truck will be sent you gladly upon request. Address Room 2007.

INTERNATIONAL MOTOR COMPANY
25 Broadway, New York

PERFORMANCE COUNTS

Mack TRUCKS

ing passenger cars in the downtown district.

As a rule the truck covers 3 or 4 blocks to get a load. As soon as it has about 4 cu. yds. of ashes it starts on its trip to the dump. This trip may vary in length from 3 blocks to 2 miles each way. Since the truck has a dump body, it takes only a moment to unload, when it starts back for the next load.

The truck has been averaging between 12 and 15 trips to the dump a day. Then at the end of the day it has the run back to Crum Lynne. On some days the truck ends up about 4 miles from the garage. It averages 40 miles a day; and in spite of a great deal of running at low speed, and the power required to operate the dump, it gets 5.7 miles to a gallon of gasoline.

Once a month the truck makes a trip to Philadelphia to bring back a load of feed. Occasionally it is hired out to do general hauling for other people. There are usually odd jobs to be had for a dump truck.

So far repairs have cost only $50.10 for a frozen radiator and a snapped spring, so $150 a year will be ample to cover this item. My time is occupied in handling the Acme truck, another 2-tonner and 16 horses, so $500 a year of my salary must be charged against the Acme. There is no charge for garage, because I keep the truck in a building of my own that would not be used for any other purpose. The cost also includes the wages of a driver at $5 a day and 2 helpers at $4 a day.

Figuring these costs on the National Standard Truck Cost System, the 2-ton Acme costs $22.17 a day, 55.42 cts. per mile, 41.07 cts. per cu. yd. and 27.71 cts. per cu. yd. mile.

I have operated horses for 25 years, and motor trucks for 3 years, and I know how they compare on every kind of work I do. On ash collection work it would take 3 teams to do the work of the 2-ton Acme. Each team would need one helper and would cost about $13 a day. The 3 teams would, therefore, cost $39 a day, or $16.83 more than the truck. Figuring that the truck operates 5 days a week, this means a saving of $4,375.80 a year.

Then, too, the horses would not be as dependable, because in hot weather they are often overcome by the heat, while in cold weather they slip and slide and often injure themselves. I have always found it hard to get their shoes sharpened in winter, because the minute there is ice on the ground there is a long line of horses waiting at the blacksmith shop.

The excellent care given the truck has been repaid by a low repair cost, and the fact that it has never been laid up for a day. This is remarkable, because the roads near the dumps are extremely rough, and the truck has to back over glass, tin cans, etc., whenever it dumps a load. In the winter the motor never stops running.

So far I have been able to keep the same driver on the Acme all the time. He is a good man, who looks over the truck regularly, and takes excellent care of it. When anything does go wrong, requiring expert attention, we get very prompt service from the Philadelphia dealer.

I have found that it pays to treat my drivers well and keep them interested in their job. If they work hard and get through early in the afternoon I always let them off for the day. This helps to keep them feeling more willing to work overtime when necessary.

The cost data follow:

COST DATA ON PERFORMANCE OF 2-TON ACME TRUCK IN ASH COLLECTION WORK

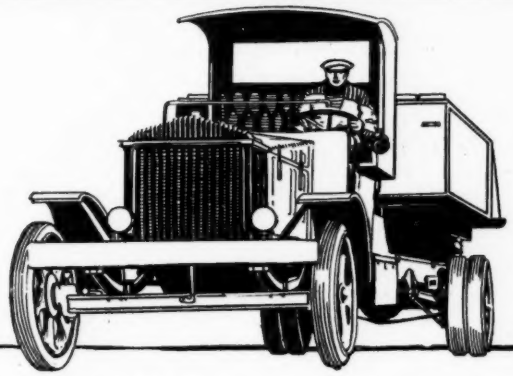
AVERAGE COST	
Cost per Day (Including Driver and Helper)	$ 22.1682
Cost per Mile	$ .5542
Total Cost for Period	$2593.68
OPERATION	
Days Operated	117
Miles Traveled	4680
Miles per Day	40
Miles per Gallon of Gas	5.7
Miles per Gallon of Oil	160
ITEMIZED COST	
Driver and Helper Cost per Day (Included Above)	$ 13.00
Depreciation per Mile	$ .0547
Maintenance and Repair, Actual, Total	$ 50.10
Maintenance and Repair, Actual, per Mile	$ .0107
Maintenance and Repair, Estimated, per Mile	$ .0144
Tire Cost, Estimated, per Mile	$ .0236

TRANSPORTATION EQUALITY AS VIEWED BY RAIL AND TRUCK MEN

To the Editor:

In the June, 1921, issue of MUNICIPAL AND COUNTY ENGINEERING I noticed an article written on Transportation Equality by Mr. M. L. Pulcher, Vice President and General Manager, Federal Motor Truck Co., Detroit, Michigan, in which he refers to the following:

"Many states are proposing legislation to limit the load that can be carried by a motor truck, to such a degree that thousands of firms, now owning heavy duty equipment, will be forced out of business



What Pierce-Arrows cost

Do you think that Pierce-Arrows are high-priced? Do you think that they cost more than other trucks?

You'll be amazed to know they cost no more than any good truck. With standard equipment added to the chassis price, they often cost less.

With the finest tool equipment and a model factory for rapid production, no well-made truck could be laid down for less. Compare our prices with any well-made truck.

Pierce Arrow

CHASSIS PRICES

2 - ton $3200
3½-ton 4350
5 - ton 4850

All Prices F.O.B. Buffalo

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

and the capital invested in their trucks will be almost a total loss; also State and National taxation of motor trucks and passenger cars is being carried to an unreasonable point." He further speaks of "the old fable of killing the goose that laid the golden eggs, as being forgotten, for the motor trucks are one of the greatest aids to commerce that we have today."

Mr. Pulcher has not considered the initial form of transportation which built up our country by spending enormous sums of money—coming direct out of the pockets of the men who had faith in developing the resources of our Western country. Those men did not have federal aid, state, county or private subscriptions to assist them in building up their roadbed to do business on. I wonder if he has ever thought for one minute what would be the condition of rail transportation if the right-of-way, roadbed and track were furnished our steam and electric roads free of charge, so all that would be necessary for them to buy would be the rolling stock?

It makes no difference how the money is acquired to build the hard surface roads, it is invested capital and is entitled to earn at least a reasonable return on the money, together with a certain sum set aside for depreciation. These items of expense should be borne by the men or firms that use the roads in a commercial way. The farmer is entitled to a good road free from any other expense except taxes, to deliver his product to the market; the same should apply to the pleasure rider or the business man. When roads are used by taxies, jitneys or commercial trucks, in competition with the pioneer builder of transportation facilities, is when the old fable of killing the goose that laid the golden egg comes in. Right wrongs no man, we need every means of transportation, there is room for them all. Every line of business should stand on its own merits, furnish its own capital to do business on, or at least be willing to pay a reasonable amount for the use of the money and bear their portion toward the upkeep.

Today the automobile and truck hold a free hand. The enormous amount of capital and material used in automobile manufacturing has been a very attractive business, both to the commercial interest and the producer of raw material. The automobile craze has been the means of many a man mortgaging his home, eventually losing all of his savings for years, to buy an automobile, for pleasure, having no other use for a machine. It has been only a few years since capital had labor down to a place where they merely existed, but today labor has capital in a much worse position. Every laboring man is entitled to his hire, but the employer is entitled to an honest day's work. Production is what this country needs more than anything else. A laborer that is interested in his home is invariably a good employee, but one not interested in his home usually does just as little as he can to get by on. When good sound business judgment governs this country again there will be plenty of work and business for everyone. An equitable basis is sure to bring quicker and better results.

Very truly yours,

E. J. PRATT, General Manager,
The Southwest Missouri Railroad Co.,
Webb City, Mo., July 5, 1921.

(The foregoing discussion by Mr. Pratt was brought to the attention of Mr. Pulcher, who has written the following reply.—Editor.)

To the Editor:

"Transportation Equality" evidently does not mean the same to all of your readers. It is, perhaps, only natural that our conclusions in this regard should be somewhat colored by our viewpoint.

Mr. E. J. Pratt, General Manager of the Missouri & Southeastern Railway, makes several statements in his letter in reply to our first "Transportation Equality" plea, which indicates that he believes motor trucks have a pretty easy time of it against the tribulations and vicissitudes of the railroad.

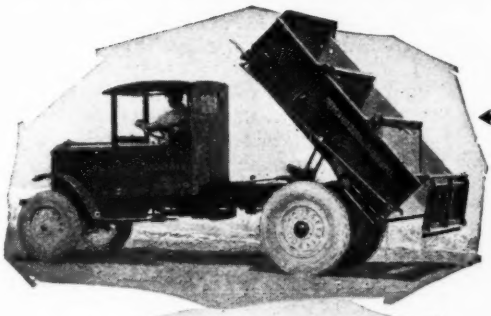
Well, as a truck manufacturer, we seek no quarrel with any railway or railway official. We acknowledge the great work of development accomplished by the railroads in the past 60 years. We deplore the period of stifling of, and legislating against, the railroads merely because they were public service corporations and seemingly legitimate prey of lawmakers.

In our article we were merely entering a plea for equality and fairness for all forms of transportation, and emphasizing the reasons why the motor truck should not be discriminated against in unreasonable laws or unjust taxes. You will doubtless remember we said:

"There are five main means of transportation today—steam, electric railways, inland waterways, motor vehicles and horses.

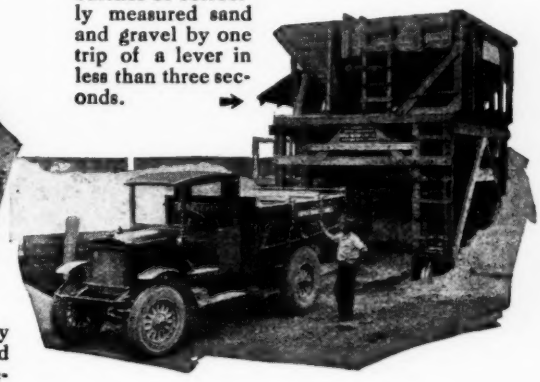
"Each one is particularly suited to certain kinds of transportation, and should be allowed to do that haulage for which

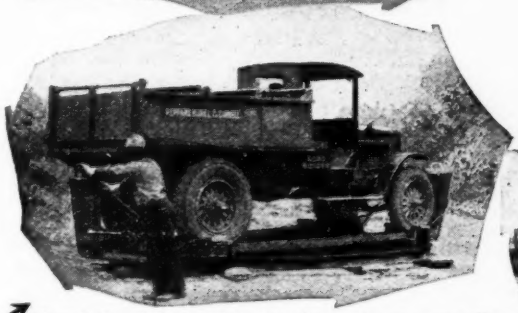
KISSEL Road Engineering Service



Kissel Special Road-builder's truck. Hydraulic dump body of three batches of one yard each—designed, geared and powered for the flexibility, proper speed and dependable service necessary to meet contractors' requirements.

Kissel Special Road-builder's truck ready to back into Kissel combination hopper that dumps three batches of correctly measured sand and gravel by one trip of a lever in less than three seconds.





Kissel Special Road-builder's truck on specially designed turntable—being completely turned around by one man in less than ten econds, preparatory to backing up to mixer.

The Kissel Road-Division Engineers and Systematizes Road Building along Proven Increased Efficiency Lines

KISSEL Engineers have proven that the motor truck is the most efficient way to transport material if properly designed and equipped. In addition, the proper facilities for loading trucks must be provided as well as for measuring material and handling the truck before it reaches the mixer.

We have gone into this work extensively and have proven that merely designing the proper trucks to haul material is only part of this work—and that it is just as important to figure out what is needed to make the trucks efficient to do hauling at the lowest possible cost.

To that end our engineers have perfected these methods and equipment and are handling the work in the most efficient manner, *second to none,* as leading road-builders and contractors in different states will testify.

We have in preparation engineering data from different Kissel equipped road-building jobs showing actual cost per batch on various length and graded hauls. Also letters from prominent contractors stating how Kissel trucks and equipment have increased their road-building efficiency. To reputable contractors and road-builders we will be glad to forward this material. Ask for illustrated story of the Johnson Creek road contract.

KISSEL MOTOR CAR CO., Hartford, Wis., U. S. A.

it is fitted, with the least hindrance. They all serve the public, which in the end is the Government. There should be no discrimination against any one of them as opposed to the other."

That is our stand in this matter. We firmly believe there is room and need for all the forms of transportation, and we believe each one should help to pay its just cost of Government expense.

Railway Subsidies

We do not exactly agree with Mr. Pratt regarding the lack of assistance given to the railways in the pioneer days. It is a well known fact the Union Pacific and other great systems in this country received bonuses in lands, and even money, for the laying of their rail lines across the country. The above mentioned road received every other quarter section of land along miles and miles of its right of way. In Canada, the Canadian Pacific Railroad stock has long sold around $200 per share, not entirely because of the value of the road, but also on account of the rich land grants made them in the early days by the Canadian Government. Many smaller roads have had direct assistance, one case in mind being one railroad in Michigan. The builders were given a bonus by nearly every city through which they planned their road. The company, or its promotors, then turned around and sold bonds for the construction of the road and pocketed the bonuses, which act we are not condemning or praising.

Further, hundreds of electric roads, the country over, have been given right of way and bonuses by city, town and county without end to place their lines as feeders to the cities and haulers for the country. The line from South Bend, Indiana, to Benton Harbor, Michigan, through the fruit belt, was built out of donations of right of way and property and tax adjustments.

So it is an established fact that the rail lines have had much Federal, state, city, town and county aid, and private subscriptions as well, to help them in their early days, and to tide them over the promotional periods.

We have recalled these facts, not to disparage or detract from anything the railway men, pioneer or modern, have done. We would but laud their success in the development of the natural resources of the United States. However, Mr. Pratt has drawn so fine a picture of the railroad beginnings that he has left out a considerable part of the background. The railways were an economic blessing to the public, and that public gave liberally from its money and resources to help the railroads, which was eminently fitting and fair.

Prohibitive Taxes

Now Mr. Pratt seems to think that railways (as he believes) have always paid all of their own way—every vehicle traveling on the highways should likewise entirely pay for and maintain the routes they use—the highways. If this is done, which is extremely unlikely, then the farm wagons, traction engines, motor vehicles and other forms of highway transporting units would immediately decrease in numbers and be operated only under stern necessity, and the whole economic fabric and marketing business of the country would suffer.

But Mr. Pratt would exempt the farmer by entitling him to a good road to deliver his products over, also the pleasure rider and business man, at no cost but ordinary property taxes. He would levy against jitneys, taxis, or commercial vehicles, in other words all competitors of rail lines, for the whole cost of the highways. He forgets that the business man, whom he exempts with the farmer from paying the cost, is the very man who operates the trucks to furnish the railway haul, or to bring raw material and products to the rail shipping point.

Many Rail Men Appreciate Motor Transport

That all railroad men do not agree with Mr. Pratt is evidenced by the statements of some of the biggest railway men in the country on the motor truck for L. C. L. shipments.

Daniel Williard, President of the Baltimore & Ohio Railroad Co., says:

"I think I realize properly the importance of motor truck transportation, and I believe it is to the best interests of the country as a whole that such transportation be developed along economic lines.

"I think there is a proper economic field for all agencies of transportation so far developed, and wherever it can be clearly shown that the motor truck can perform the transportation service required at a total economic cost lower than the cost where the railroad is used, then in the public interest the motor transport system should be used. The railroads and the motor truck each have their own sphere of economic usefulness, and, in my opinion, it would be a mistake for either one to extend its influence and activities beyond the economic limits thus clearly established."

C. A. Phelan, General Manager of the Missouri-North Arkansas Railroad Company, says:

"There is no question but what the motor truck is a great asset in the handling of freight to and from the railroads to the interior country, and there is an opportunity for considerable development along such lines in this country."

J. F. Gorman, President of the Chicago, Rock Island & Pacific Railroad Company, says:

"There is no question of the value of motor trucks in serving rural communities, and I think equally they can be used to advantage in the transfer of freight in the large shipping centers, replacing trap cars now used for that particular purpose, which experiment has been tried in at least one important city.

"Good roads are necessary for the development of the motor truck transportation, and the large sums now being applied to this particular purpose in almost all parts of the United States, if expended at proper locations, will enable the motor truck to serve well many localities not now adequately served by the railroads."

Not only does the attitude of these railroad men toward the truck reflect the true status of the two forms of transportation, but it conveys the thought that it is the wise thing to do to contemporize the two greatest transportation methods in the world today.

The Trucks Are Paying, Yes Indeed

As far as paying a share of this cost and maintenance of the highways, the trucks certainly are doing that. Last year the combined automotive industry paid $316,720,878 in taxes—and so many kinds of taxes, too—Federal, excise, registration, license, motor fuel, motor transportation franchise tax, mileage tax, business taxes on manufacturer and dealer, horse power taxes, weight taxes, personal property, chauffeur, driver—almost no end of taxes. Much of the moneys thus received are spent for cost and maintenance of the roads, which, as we have said before, is proper and fitting. But our protest, feeble that it is, is towards the $500 to $2,000 per vehicle which is being levied against some capacities of trucks in some states; not just heavy duty trucks either. In one state it will cost over $1,000 taxes to operate a 2-ton truck if the law is enforced. In many others no 5-ton truck, even adequately tired for road conservation, can operate without paying more tax to the state than the gross haulage receipts would amount to.

This legislation and taxation, we maintain, is not helping solve the country's transportation problem, nor settling the question of who should build and keep up the highways, nor which is the best way to ship goods for short or long haul, but the attitude of lawmakers is directly in opposition to the settlement of these matters. We do not believe that the great American public, which was so long denying to the railroads a proper freight rate, will permit the crippling of another form of transportation through excessive taxes. We believe that fairness and common sense will prevail in the end—but truck operators are suffering now. Why not relieve this situation now?

Natural Economic Selection

And so we could go on expressing our own and others' opinions regarding the functioning of the railway and motor vehicle and of the right and wrong of the distribution of cost and maintenance of highways, adequate to the demand of the country upon them—but it would avail us nothing. The economic necessity will in the end govern the situation. If the nation needs more motor truck transportation than it has ever had, then the trucks and the roads will be built to haul the goods, and if the trucks can most economically haul those things which are best suited to that form of transportation, or which must be transported where the rails don't reach, then where is the argument—why the discussion? As always, the old law of average takes its stand where none can move it. Business will go on and the world will raise, sell, trade and barter, and the result is transportation—more and faster transportation. Let's not have words about the means. Let's only have to do with the most available and economical means at hand and use that as often as the need arises. Very truly yours,

M. L. PULCHER,
Vice-President and General Manager,
Federal Motor Truck Co.
Detroit, Mich., Aug. 11, 1921.

MOTOR BUS SERVICE FOR CONSOLIDATED RURAL SCHOOLS

(Editor's Note: Following is the full text of the report of the Committee of the National Highway Traffic Association appointed to study this subject. Ernest Farr, chief of the Firestone Ship by Truck Bureau, Akron, O., is chairman of the committee. Other members are: L. L. Driver, Director Bureau of Rural Educa-

tion, State Dept. of Public Instruction, Harrisburg, Pa.; R. P. Crawford, Assoc. Editor, Nebraska Farmer; and Macy Campbell, Head of Dept. of Rural Education, Iowa State Teachers' College.)

This report will be confined to brief discussions of recent progress in rural school consolidation, the use of the motor bus for the transportation of pupils and the development in equipment, and a somewhat more elaborate discussion of the relation between school consolidation and motor transportation of pupils., Subjects of local importance or which must be worked out as individual problems for each installation, such as operation details, will not be touched on. Also the relation between consolidation and transportation will be developed to apply only to those districts in which conditions are unfavorable to consolidation.

Number of Consolidated Schools

At the beginning of 1920 there were about 13,000 consolidated schools in the country and 212,000 one-room schools, which should provide a field for about 40,000 more consolidations. Exact figures are not available, but it is believed that 14,000 is a conservative estimate of the consolidated schools now in operation and that there are 3,000 to 4,000 more in prospect. Pennsylvania alone is working on 200 consolidation projects.

Educators are becoming more intensely interested in consolidation. It means a raise in the standard of teacher, personnel and pay, a subject that is being agitated throughout the country. Many institutions of higher education, such as Kentucky State University and Kansas State Agricultural College, are including the subject of consolidated schools in their extension courses. Women's clubs are interesting themselves in consolidation campaigns. The United States Department of the Interior is assisting in the consolidation movement and has the cooperation of the Department of Agriculture through its county agricultural agents.

Progress of Motorization

So much for the progress of consolidation. What is of more interest at this time is the question of transportation. The following quotation is from a letter received from Mr. Lee L. Driver, Director, Bureau of Rural Education, Pennsylvania Department of Public Instruction: "Hundreds and thousands of places are finding that the motor can be run where it used to be thought impossible. They are also finding that it is cheaper when service is considered. Many communities have not purchased horse-drawn vehicles for two or three years and are relying wholly upon the motor. In Pennsylvania more motors are being used than horse-drawn vehicles."

One county superintendent in Ohio reports that last year they had 20 automobile buses and this year they have 60, and probably will be completely motorized within a short time. Cuyahoga County, Ohio, reports that no more horse-drawn vehicles will be purchased. Montezuma County, Kansas, expects to be completely consolidated this year, with six schools, using 50 buses, serving the whole county. The State of Washington, in the northwest, reports that motor buses are the principal transportation medium and the State of North Carolina, in the southeast, reports that motor buses are displacing horse-drawn vehicles.

It will be seen that the motor bus is rapidly becoming the recognized transportation medium where consolidation is in effect. Transportation is the most vital factor in rural school consolidation and, where consolidation is not in effect, the principal stumbling block in the path of its attainment is the question of transportation. It is for this reason that this report is largely devoted to a discussion of the importance of transportation to consolidation.

Consolidation Depended on Transportation

As a foundation for a case for the motor bus it may be well to show just how dependent consolidation is on transportation. The two are so closely allied it is impossible to discuss them separately. To support a consolidated school, the district must be large enough to furnish an adequate tax duplicate. When an area of that extent is included transportation must be provided or a large percentage of the children in the district cannot attend, and it is not to be expected that a parent will vote to tax himself to maintain a school not available to his children. Without going into details, a compilation of several recent articles on consolidation gives 56 different advantages the consolidated school has over the old rural school. Of these 56 advantages 14 are the direct result of furnishing transportation. The balance are dependent on transportation, at least to the same extent as is consolidation, which is close to 100 per cent.

The transportation of school children should be measured by time rather than distance. If a pupil be required to ride over one hour each way the undue fa-

tigue probably will reduce his general efficiency, not to mention the fact that he may not have sufficient time left for necessary duties on the farm. A comparison of horse and motor bus transportation on this time basis is interesting. It may be estimated conservatively that six miles, including necessary stops, is the maximum distance for a horse-drawn vehicle in one hour, and that under similar conditions the motor bus will make 12 miles. In other words, the use of motor buses will quadruple the size of a district which may be served by a consolidated school, at the same time transporting the pupils in an equal length of time as well as in equal or greater comfort than if they rode in horse-drawn vehicles.

Returning briefly to the 56 advantages previously mentioned, 21 are directly dependent on the increased size and equipment of the school and 12 on the increase in number of pupils. Therefore, by multiplying the possible area by four the motor bus not only enhances the efficiency of the majority of consolidated schools but enables their establishment in districts where the area practical for horse-drawn vehicles can not produce the necessary taxes to support the school and pupils to patronize it.

As an example, take the State of North Dakota. It may be assumed that a maximum travel distance of six miles is a maximum air line distance of three miles from the school, since as a rule the roads follow section lines and more or less doubling along the routes is necessary. This makes the maximum area of a consolidated district a circle of three miles radius, or about 28¼ square miles. Now the average assessed value of land in North Dakota is $3,750 per square mile or $106,000 in a district of 28¼ square miles. This means one of two things if horse-drawn vehicles must be relied on: an open country consolidation which does not have the tax duplicate of a town or city to support it cannot exist, except as an incompletely equipped plant, little superior to the one-room school, or the district must be extended so that many of the pupils spend three to five hours a day traveling to and from school.

Other considerations are density of population and topography. On the average, in North Dakota, there would be only about 62 school children in a district of 28¼ square miles of area. In the valleys of the eastern mountains and the canyons of the western, topography frequently makes consolidation impossible unless motor buses are used. Consequently it would seem that consolidation is absolutely dependent on motor bus transportation where average land value is low, where population is scattered or where topography necessitates a long, narrow district.

Cost of Motor and Horse Transportation

Enlarging a district increases the average transportation distance per child per day, so it may be well to compare in a general way the cost of motor bus and horse transportation. A compilation of the records of various schools representing all sections of the country shows an average transportation cost of 1.8 cts. per child mile by motor bus and 3.0 cts. by horse hack. Still assuming that the bus is capable of double the time mileage possible by horse, and assuming districts of a maximum size of one transportation hour, the cost of transporting the average pupil will be 20 per cent greater by bus than by horse hack. Transportation cost amounts to about 10 to 15 per cent of the total cost of tuition. Therefore, under the most unfavorable circumstances the use of motor buses will increase the unit cost of tuition about 3 per cent, but at the same time it offers the compensating advantage of a district of quadrupled area, greatly increasing the possibilities of economies in other directions. For instance, doubling the investment in the school plant should be more than sufficient to give equal advantages to four times the pupils, thus reducing the amount of taxes necessary to retire bonds by 50 per cent.

Improvements in Buses

Taking up the subject of bus equipment, many improvements have been made recently. Several manufacturers of trucks and bodies have given the school bus special attention, with the result that there are now on the market several standardized buses providing maximum value, seating capacity and comfort at minimum cost. While it is important that each installation be studied as a separate problem, the general tendencies in chassis and body construction should be noted.

Where replacement equipment is being purchased the tendency is to get away from the light chassis and use those of larger capacity, the 1-1½ ton being the most popular. This is an important and an apparently well-founded development from the standpoint of safety as well as economy.

Bodies may be divided roughly into two classes—the side-seater and the cross-seater. The side-seater gives a minimum of comfort and seating capacity. A recent

development of the side-seater has an extra seat down the center, accommodating three rows of pupils lengthwise in the bus. This gives added seating capacity, but is not all that could be desired so far as comfort is concerned, and is rather unsafe unless a rear door is provided, which, in turn, reduces the capacity. The cross-seater is of two general types, one having individual side entrances and the other having an aisle down the center and rear and front doors. Considering seating capacity, comfort and safety in their relative importance, it is believed that the last mentioned type is the best for the average installation.

Motor Bus Dependent on Good Roads

The dependence of consolidated schools on motor transportation has been emphasized. In conclusion, it should be stated that the motor bus is also dependent on, and greatly limited by, a very important factor. From all over the country come reports substantially the same as that contained in a recent communication from J. C. Nuerman, Specialist in Rural Education, Department of the Interior. Mr. Nuerman says: "Until we have a better system of roads and more money for roads I do not look to see the consolidated schools advance as rapidly as they will when the good roads problem is settled."

DETROIT MUNICIPAL STREET RAILWAYS OPERATE NEW TROLLEY TOWER TRUCK

The accompanying illustration of the "Standard" hydraulic elevated trolley tower truck, now being used by the Municipal Street Railways Department of the city of Detroit, shows an unusual installation of the tower and body arrangement. The tower can be elevated or lowered in less than a minute by moving a lever which is within reach of the driver's seat. It is the first tower of its type built.

A three section Trenton tower is located between the cab and body. The tower is operated by a Wood Hydraulic Hoist, located on two cross members in the center of the tower. The hydraulic hoist is hooked up with the hand hoist arrangement so that in case of emergency, or when the motor is not running, the tower can be raised easily by one man turning a crank. The tower lowers by gravity and the hand arrangement is fitted with a brake to control the downward speed of the tower.

The enclosed cab has sliding doors and is fitted with an auxiliary roof to allow the workmen to walk on it. A ladder shaped to the contour of the cab side is attached to provide means of getting on the tower platform.

The body is equipped with four longitudinal tool boxes. The two inside tool boxes are full length of the body and the two outside ones, which are longer, straddle the tower frame.

There are six double 8-in. hooks attached to the body posts for hanging on coils of rope and wire, etc. The inside

"STANDARD" 2½-TON HYDRAULIC ELEVATED TROLLEY TOWER TRUCK.

tool boxes will be used as seats for the workmen. The passageway between them has provisions for removable partitions to make four extra large compartments. The covers of the outside tool boxes are on an angle so arranged as to keep the contents dry in wet weather. A step and a hand rail at the rear end of the body make it easy for workmen to get tools and material from the inside tool boxes and compartments. The body can be completely enclosed in inclement weather with curtains that are rolled up and attached to the top of the body. The chassis is equipped with a pintle hook and both front and rear tow hooks.

The electric lighting equipment consists of two head lights, one tail light, two dash lights, one spot light and searchlight. The searchlight is mounted on the top of the cab and is so arranged that it can be swung in any direction to illuminate the work while repairs are being made.

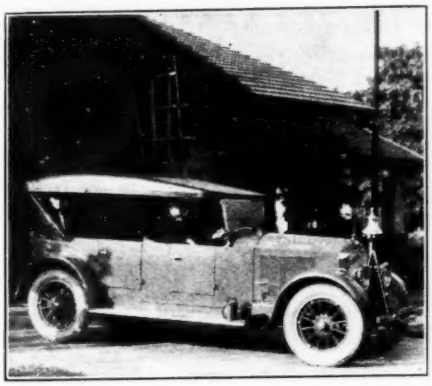
The total height from the ground to the tower platform when elevated is 19 ft.

6 ins.; when lowered it is 10 ft. 4 ins. This truck is manufactured by the Standard Motor Truck Co., Detroit, Mich.

NEW CAR FOR THE FIRE CHIEF

Because of the ease of control, coupled with high speed when required, much interest attaches to the National Chief—a new fire chief's car built around the standard National Chassis by the National Motor Car & Vehicle Corporation, Indianapolis, and sold through the representatives of the Stutz Fire Engine Company. The first of this series has been delivered to Mr. Matheny, who represents the Stutz Company in Kansas City territory.

The car is finished in brilliant vermillion with bright nickel fittings. A special fire bell is mounted at the front with pull cord leading through the dash. An attention getting electric siren is also provided. A removable high power electric lamp is mounted on the running board so as not to interfere with speedy entrance and exit from the car. A Pyrene is fitted under the front seat on a special clip floor board mounting.



THE NEW "NATIONAL CHIEF" FIRE CHIEF'S CAR.

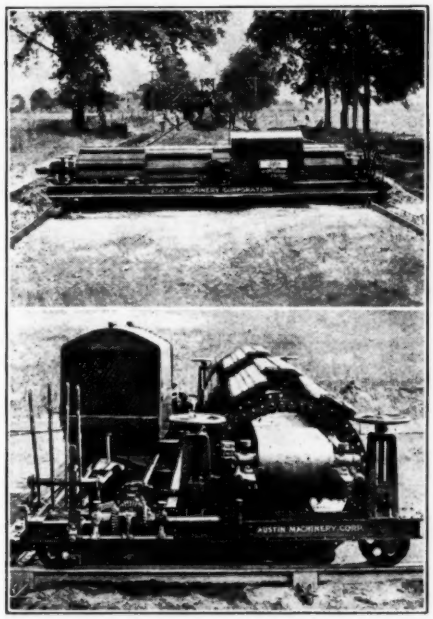
The National Chief is furnished in either roadster or seven passenger types. The roadster follows the general lines of the standard National Sport model with an extra disappearing seat in the rear. The lines are so distinctive that it is recognized at once as an afficial car.

The National Chief, with seating capacity for seven, is very appropriate for municapal turnouts and parades, as well as regular fire duties. Speed has not been sacrificed in furnishing the extra seating capacity. Another attractive feature is that aside from fittings and finish both models have a regular stock National chassis, thus in case of accident repairs and replacements can be made very easily and quickly.

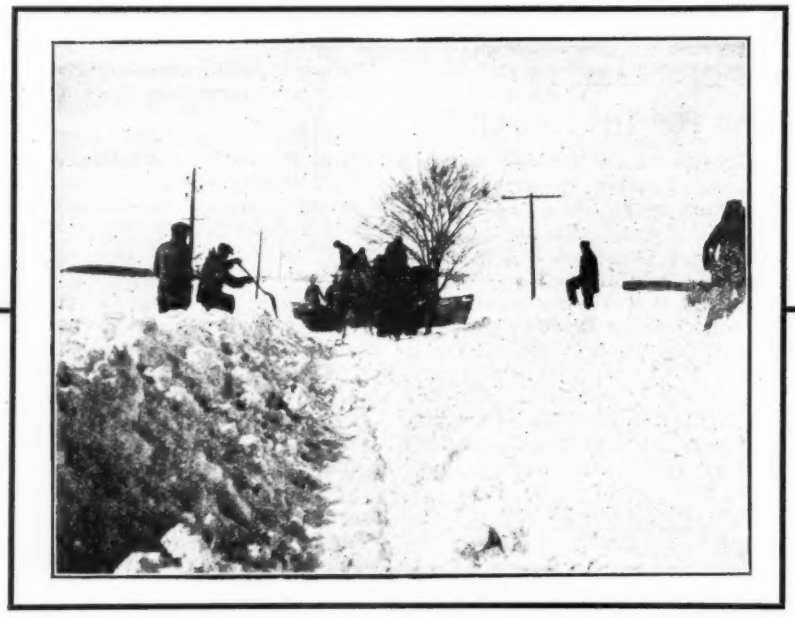
THE AUSTIN SUB-GRADER

With five billion dollars already appropriated for highway construction in the United States during the next ten years, road engineers and contractors are looking into every means which will assist in the efficient building of enduring concrete highways. As an additional step in meeting this demand, a new Sub-Grader has been put on the market, designed primarily to effect a labor saving in finishing the road after it is rolled prior to putting on the concrete. In addition to the lessened number of men on the job, the mechanically true grade means a substantial saving on concrete.

This Austin Sub-Grader, one-man, gasoline operated, is drawn along on the Road Forms by means of cables. The 4-ft. digging buckets, equipped with removable steel plow lips, are set to drive in five distinct places to depths varying from 2 to 4 ins. In trimming the road, two plows shave off the sides between the forms and the buckets. The buckets then trim the road, depositing the excavated material on the 15-in. conveyor belt, which discharges the surplus material outside the forms. One passage over the road leaves the sub-grade perfect for the laying of the concrete.



VIEWS OF THE AUSTIN SUB-GRADER.



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ADJUSTABLE WINGS

For wide streets or narrow roads, the adjustable Phoenix will clear any space from six to twenty feet, and with its special adjustable center plow work to any depth desired.

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EDITORIALS

PERMANENT RESULTS FROM EMERGENCY PUBLIC WORKS.

President Harding's Conference on Unemployment, through a committee, has urged upon municipalities, counties and states the extreme desirability of getting new public improvements under way at once as a means of providing employment for those who are idle. The recommendations of the committee are published in this issue and will naturally receive the attention of every reader.

The point is being raised in some quarters that if the federal government looked with disfavor on a grant from the federal treasury to the unemployed it is not fair to expect local authorities to "make work" just to help the idle at public expense. This view merits attention, although it is not widely entertained, because it misses the point entirely. It has not been the thought, at any time, of those who have urged the undertaking of improvement projects as a means of providing employment that such a course should have merely temporary benefits to an unfortunate minority.

These emergency measures are not disguised charity but are calculated to make charity unnecessary. Only useful work of permanent value should be undertaken. Fortunately there is plenty of useful work to be done in every locality where there is a real unemployment problem present or in prospect.

Sound procedure is illustrated in the case of the city of Boston, where a special effort has been made to get started all the public work which has been determined upon as a matter of policy. City contracts have been placed for new buildings amounting to $2,746,200. Repairs and renewals, subway work and Public Works Department requirements, etc., bring the total up to a little over $4,000,000.

In August $106,000,000 worth of municipal bonds were sold by 333 municipalities, and to the end of September such bond sales are $700,000,000 in excess of the total for the entire year 1920. Thus there is much money available for public improvement work on projects which have been carefully considered and fully planned. Construction work should go forward at once on all such projects, in the opinion of the President, Secretary Hoover and scores of others of the highest authority who have carefully considered all phases of this subject.

RATING CITIES ON THEIR PUBLIC IMPROVEMENTS

Many readers undoubtedly are familiar with the procedure of the National Board of Fire Underwriters in rating the water supply and distribution works of a city with respect to the adequacy of fire protection they furnish. The rating is based on a clearly defined and easily understood set of standards for the various features of a water system, and the city is rated as a fire risk in accordance with the deviations of local facilities from the established standards, and thus the fire insurance rates are fixed to a large degree. Water works that look complete to the layman, and even to the local water superintendent, are shown to be incomplete and inadequate by comparison with the established standards.

It would be of great interest and value to have standards with which cities could readily compare the completeness and adequacy of all forms of improvements. When is a city adequately paved? When is a city adequately lighted, sewered, etc.? These questions cannot be answered at this time for lack of recognized standards.

It would seem to be as feasible to prepare standards for comparison of other public improvements as it is for water systems, and the need is just as great although of a somewhat different character. The reader will appreciate the many advantages to a city in having recognized standards with which to compare its public works of all kinds. We should like to see this matter taken up and made the subject of an investigation and report by a committee of some national engineering society.

WEALTH, HEALTH AND THE MUNICIPAL ENGINEER

A distinguished British municipal engineer, who has published a 120 page vol-

ume of his professional reminiscences to give the general public a better conception than it now has of the work which devolves on a municipal engineer, in a recent letter to the editor of The Surveyor and Municipal and County Engineer, of London, inquires why it is that municipal engineering receives so little encouragement from local authorities and the general public. He quotes the following passage from "The Life of Lord Warwick": "While the soldier, sailor, diplomat and politician reap their substantial rewards, none is ever offered to those who carry the heavy burden of municipal responsibility and work." He asks what is to alter this apathy towards men who are giving the best of their lives and ability to the work of improving the surroundings and amenities of their fellow citizens, and who are responsible for so much that make life worth living. He feels that their labors should command some "substantial rewards" instead of the present meagre salaries which are so often grudgingly bestowed on them.

While these points were made with respect to the employment conditions of municipal engineers in England they apply equally well to conditions in America. Therefore his answers to his questions have an interest to American municipal engineers.

His explanation of the conditions described lies in the fact that the labors of the municipal engineer bring in no direct monetary return, and consequently his work is not valued in the same manner as that of the employees of a commercial enterprise. He concludes: "The majority of mankind is apt to place a higher value on wealth than on health, whereas a wise man knows that the latter is of infinitely greater importance. Until this is more fully realized I fear that the chances of a better recognition of the services of the municipal engineer are somewhat remote."

The editor of The Surveyor makes interesting comments on the observations of his correspondent. He says: "Long experience has shown that to secure an improved status for the municipal engineering profession it is not sufficient merely to reiterate the fact that the present position is neither satisfactory to the public nor just to the municipal engineer. The careful inquirer will go a step further and ask what are the reasons which lead to an attitude of mind on the part of local authorities and the general public that results in a common failure to appraise efficient civic engineering service at anything like its proper value, whether this be measured in the benefits conferred on the community or in the remuneration which the engineer receives for his work." He agrees with his correspondent that "all save the wise are apt to place a higher value on wealth than on health, and even when health is considered at all, it is surprising how little attention is bestowed on preventive as compared with curative processes. The work of the municipal engineer does not bring in an immediate cash return, but is concerned with the health of the community, which he preserves by preventive measures. It would appear, then, that municipal engineers will not receive full recognition until the advent of a saner general outlook on life. Meanwhile the only hope of improvement seems to lie in a missionary campaign among members of local authorities."

Probably our readers will agree with this diagnosis of the case and also that the remedy proposed is good. We maintain that through proper publicity the general public, as well as the higher officials, can be made to appreciate the service of the municipal engineer and its money value to the community. Recently it has been demonstrated that the public can be interested in the fair treatment and adequate compensation of its servants, as in the cases of public school teachers and postal employees.

Municipal engineers can secure better compensation and longer and more secure tenure of office whenever they make up their minds to go about it. They must tell the public, and public officials, of the money saving possibilities of good engineering and of the money wasting possibilities of poor engineering, and of the value of good engineering as health insurance as contrasted with the menace to the health of the community inherent in poor engineering. This is not a visionary proposal but is intensely practical. It will not be necessary to go to the public with generalities, but any number of deeply impressive facts and figures are available for immediate use; facts and figures which will convince the people and elected officials that competent municipal engineers should be well paid and protected against the machinations of the machine politicians.

BITUMINOUS PAVEMENT DESIGN —AGGREGATE SURVEY

(Copyright, 1921, F. S. Besson)

By F. S. Besson, Major, Corps of Engineers, U. S. Army, Assistant to the Engineer Commissioner, D. C., District Bldg., Washington, D. C.

Certain investigations recently made in the District of Columbia have shown clearly that defects of bituminous pavements can not be charged entirely to deficient compaction, nor to the presence of smooth grains in the aggregate, nor to the existence of rigid bases. Poor pavements result from various causes. Failure may be due to poor design; to the bitumen content, or to the aggregate employed. As an aid to proper design a diagram was developed which is reproduced herewith. See Fig. I. By the aid of this diagram the bitumen requirements for what may be called a "normal mix" may be readily determined. It was fully realized that the proper bitumen content would not always assure a satisfactory pavement, and therefore further investigations have been made in an attempt to discover other causes of failure and to place the theory of bituminous paving design upon a practical basis.

Most pavement and floor mixtures used throughout the United States are prepared according to one or another of several well-known or patented formulae which call for combinations of aggregates in accordance with specified sieve analyses. Artificial mixtures are usually expensive. In some parts of the country the cost of the generally advocated mixtures is absolutely prohibitive. If it can be shown that natural aggregates found locally will give equally good results, the economy which will follow is quite apparent.

Two Outstanding Features in Design of Bituminous Mixtures

There are two outstanding features in the design of bituminous mixtures:

a. Each combination of sand, stone or gravel requires a different amount of bitumen, for what may be called a "normal mix," see Fig. I.

b. Some aggregates, no matter what the bitumen content, fail to be of value as paving mixtures. By varying the bitumen content with other aggregates, mixtures applicable to widely different uses may be obtained.

As already stated, the proper bitumen content for the "normal mix" for any aggregate may be determined by using the diagram shown in Fig. I. The specific gravity and voidage of the aggregate are obtained by placing a 1000 gram dry loose sample in a graduated cylinder, 62 mm. in diameter, using gasoline for submergence. For general street and road purposes, mixtures falling on the curve when

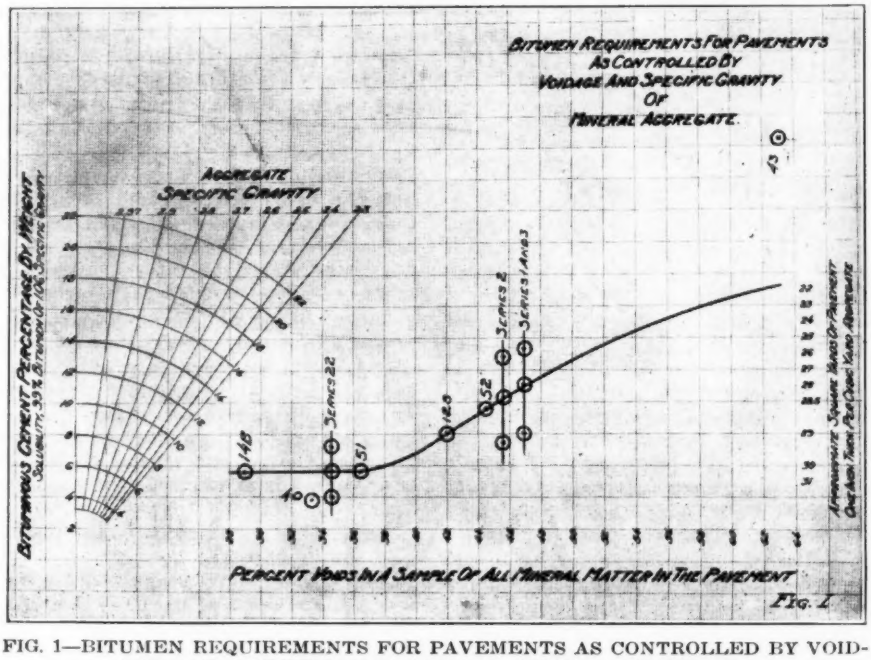

BITUMEN REQUIREMENTS FOR PAVEMENTS AS CONTROLLED BY VOIDAGE AND SPECIFIC GRAVITY OF MINERAL AGGREGATE.
AGGREGATE SPECIFIC GRAVITY
BITUMINOUS CEMENT PERCENTAGE BY WEIGHT
SERIES 22
SERIES 8
SERIES 1 AND 3
PERCENT VOIDS IN A SAMPLE OF ALL MINERAL MATTER IN THE PAVEMENT
FIG. 1

FIG. 1—BITUMEN REQUIREMENTS FOR PAVEMENTS AS CONTROLLED BY VOIDAGE AND SPECIFIC GRAVITY OF MINERAL AGGREGATE.

plotted on the diagram will be correctly designed, so far as the bitumen content is concerned. If a mixture is desired for other purposes the diagram supplies a definite basis for investigation.

Plotted on Fig. I are some specimens to which further reference will be made in the present discussion. No. 40 is a sample from a recent paving job, illustrating what is generally known as a "lean asphaltic concrete." A seal coat is just as essential with this mixture as with a penetration macadam pavement, and such a coat in this particular case costs approximately 8 cts. per sq. yd. It may be questioned whether better service

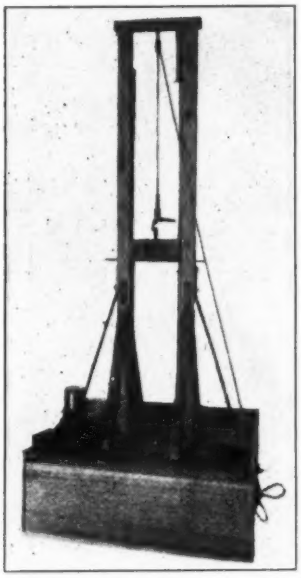


FIG. 2—APPARATUS FOR MAKING AND TESTING BLOCKS.

could not be obtained by improving the primary mixture 8 cts. worth, making it denser and richer, thereby doing away with the necessity for the seal coat. It is plainly evident that some means must be devised to test the relative worth of bituminous mixtures as affected by the aggregates employed, and this comes under the second of the two outstanding features in pavement design.

Specimen "12S" represents a sample taken from a pavement, probably one of the oldest serviceable sheet asphalts in this country. The fact that the mixture is most excellent is proven by its life of 42 years and by the further fact that the service it is rendering today is more economical, the maintenance cost much less, than that given by other surfaces but half its age. This pavement was laid without a binder course. In developing a standard practice in the District of Columbia by the "mix and try" method extending over practically half a century, a great number of experimental pavements have been laid. The worth of each has been tested under service conditions. Many early proved of no account while others, though differing greatly among themselves as to structure, have given good results. It happens, however, in considering certain pavements to determine final design this "12S" type was not chosen and a standard was finally adopted calling for a topping mixture of about 11 per cent bitumen underlaid by a 1½-in. binder course.

Three Elements in Bituminous Pavements Which May Cause Failure

In any bituminous pavement composed of binder and topping there are three elements to which failure may be attributed: the binder, the bitumen in the topping and the mineral aggregate. Which of these three should be blamed in case the pavement fails has many times been a matter of mere conjecture. Carrying out investigations along lines suggested by the old pavement, specimen "12S", other examples have been found which indicate clearly that the binder course is unnecessary. Its complete elimination is advocated and this will do away with one of the three elements to which failure has been charged. Furthermore, based upon 100 as the cost of a 3-in. surface comprising 1½-in. binder and 1½-in. topping, the former has generally cost 43 per cent and the latter 57 per cent. But entirely omitting the binder course the cost may be proportionately reduced. Since the surface without the binder course is but one-half the usual thickness, in repair work less material is needed for patching and the maintenance cost is likewise reduced. The base underlying an asphaltic pavement should be considered as permanent construction with an indefinite life whereas the surface must be replaced periodically. If only a topping mixture covers this base, when re-surfacing is necessary but one-half the usual thickness has to be stripped and replaced; again the material salvaged has more value than if half of it consisted of binder. To offset these economies no good reason whatever for placing a binder course between the base and the topping has been found.

Years ago many bituminous cements were of an unstable nature. Even when they were made with a good native asphalt as a base unsatisfactory results were often obtained because of the many

poor fluxes then on the market. Today bituminous materials are controlled by accurate specifications guaranteeing uniform products. Having at hand what is known to be a good cement, the diagram, Fig. I, determines the quantity to use for a "normal mix." Though thus working from a known basis as regards the bitumen requirement of any aggregate, the worth of the resulting mixture in its application to specific purposes is still undetermined. Heretofore, experience under service conditions has been the sole criterion with a marked hesitancy in departing from known standards. In the paving industry nothing can ever entirely supplant practical experience. However, it is essential to have a method of testing bituminous mixtures in order reasonably to forecast what may be expected under actual service.

Investigation of Different Mixtures

In order to carry further the investigation of different mixtures, the apparatus shown in Fig. 2 has been designed. Cylindrical compressed blocks, 10 c. m. in diameter, are made of the mixture to be tested. Each block contains 1,000 grams of mineral aggregate and as many grams of cement as may be necessary to give the desired percentage of bitumen. The block is placed in the apparatus and over it is centered a steel pin 19 m.m. in diameter, which is subjected to blows from a 20 kilogram weight falling through a distance of 0.8 meter. After a number of blows it is found that the pin either fractures the block or penetrates it to the full length of the pin, 60 m.m., accompanied by more or less cracking. A record of the number of blows and of their general effect, together with a close study of the tested blocks, supply sufficient data for satisfactory conclusions concerning the different mixtures.

Study of Cracked Pavements

The deductions from such tests must necessarily be based upon the behavior of sample blocks taken from pavements which have been subjected to service tests and whose behavior has been noted carefully. By testing such blocks from existing pavements it is possible to form accurate conclusions concerning the behavior of experimental mixtures. The material in block "48S", Fig. 3, was taken from one of the most conspicuously cracked pavements in the District. This was laid in 1903 and the defects appeared shortly thereafter. The "2" in the upper right hand corner records the number of blows delivered in breaking the block. The next specimen "15S" shows a friable mixture which broke down under but one blow.

The many cracks in some Washington streets are quite apparent and it is obvious that there is something wrong with pavements which behave in this manner. Samples taken from these cracked pave-

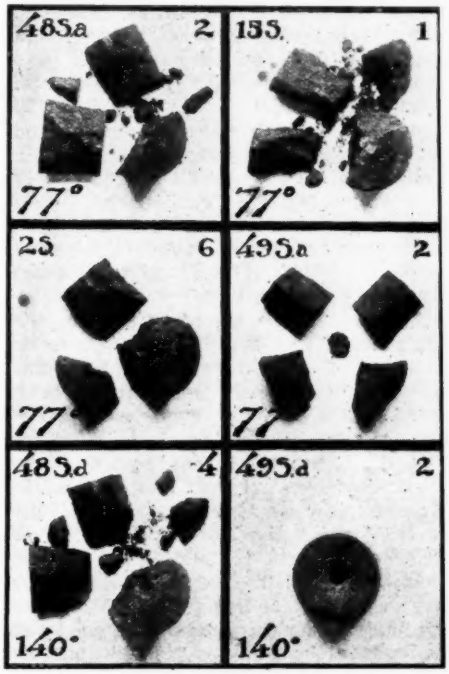


FIG. 3.

The upper left hand figures are specimen numbers. Those in the upper right corners the number of blows delivered and those in the lower left, Farenheit temperatures. These specimens represent good and bad streets. No. "48S" a much cracked pavement and "49S" a waved one. No. "15S" a worn out surface, and "2S" a good one in its prime. The "d" blocks show the relative influence of high summer temperature. These six photographs serve as standards. If an aggregate gives similar specimens to one of these a primary assumption is that it will render analogous service in a street. Such a comparison is the first step in the complete survey of an aggregate.

ments habitually give block tests similar to "48S" and to "15S." Therefore, like results in the case of new mixtures would caution against their use in actual practice. As a contrast to these two samples, specimen "2S" was obtained from a street laid in 1905. Under heavy traffic it has given uniform, economical and satisfactory service. An experimental mixture giving a block test similar to "2S" might be looked upon with tentative favor.

A Study of Waved Bituminous Pavements

Cracked and good pavements are illustrated by the specimen blocks already mentioned. Waved pavements call for special study. In an endeavor to investigate such pavements by the block test trouble was had at first in determining the cause of this most objectionable defect of bituminous mixtures. Though many blocks were broken it was found that those from waved pavements gave about the same results as those from cracked surfaces. For example, "49S" represents a much waved pavement and yet it closely resembles "48S" from a badly cracked pavement. It is apparent that each of these two is poor, but a correct determination of the causes of failure can not be drawn from the photographs showing the behavior of these two specimens.

A study of the waved streets in the city showed that maintenance is heavier during the hot summer months than during the winter. Furtherfore, it has been found that waved pavements can be ridden over with more comfort in winter than in summer. In cold weather the bumps iron out, but they re-appear again when warmer weather comes. This suggested making the block tests at higher than usual room temperature. A thermometer buried in a street on a summer day registered as high as 140° F. Accordingly a series of tests was made as represented by samples "48S.d" and "49-S.d" marked 140° in the lower left hand corner of the photographs. It is easy to determine which of these two pavements cracked and which waved. A specimen from the former breaks somewhat similarly to a good specimen at average temperatures. The one from the waved pavement is so soft that the pin readily penetrates. Just the opposite to waved pavements, observation has shown that streets which crack badly generally show greater deterioration in winter weather, while they render fair service in the warmer summer time.

Usefulness of Block Tests

The actual usefulness of these block tests depends upon our ability to draw proper conclusions therefrom, based upon the behavior of similiar blocks than from pavements tested under service conditions. In order to determine the value of any particular aggregate, all of the elements of bituminous design must be known. The diagram, Fig. 1, will give the amount of bitumen for the "normal mix" and thus fixes that element which has heretofore been one of the greatest uncertainties in paving practice. Care must be taken that the results of the block test are not affected by temperature changes or by variations in the consistency of the bituminous cement. The blocks must be made and tested under constant conditions. In all the investigations described herein successful results are largely due to the painstaking assistance rendered by Mr. Vernon Cleaver of the Engineer Department of the District.

While the block test alone can not determine all of the causes of defects in old pavements, it can aid in preventing their occurrence in new ones. The succeeding photographs illustrate how, with this aim in view, a sample aggregate may be investigated. In order that the results might be strictly comparable the same bituminous cement was used in all of these blocks.

As a preliminary study, this cement was mixed in varying amounts and of different consistencies with proven aggregates. For instance, a tested block containing aggregate extracted from the street previously referred to by the symbol "12S" is shown in Fig. 4. The cement tested 45 units penetration at 77 deg. F. By this means it is possible to establish models that may be used as standards in investigations of unknown aggregates.

Discussion of Tests

The previously mentioned specimen "40" is shown in Fig. 4. The material for this block was taken at the asphalt plant from a truck just loaded for delivery to the street. This mixture contains but 4.5 per cent bitumen soluble in C. S. 2, insufficient properly to bind the aggregate. Particularly it should be noted that though the larger stones are rough and angular, being a crushed trap rock, they do not form a properly consolidated conglomerate. Under but two blows the block is torn apart rather than broken, there being no planes of cleavage through the stones themselves.

No. "14b" is shown as a contrast. The coarse aggregate is smooth quarter and half inch gravel. The 6.1 bitumen percentage is normal for the 29 per cent aggregate voidage. In the plane of fracture it is seen that the larger material is not torn from the surrounding binding matrix. Not only do the half inch pebbles break cleanly but also the quarter inch ones. The bitumen and fine grain material form a binding agent that develops the full strength of the particles of stone aggregate.

Specimen "43" plotted on the diagram Fig. 1, and shown by photographs in Fig. 4, is an extreme mixture. The mineral aggregate is very fine, all passing the 200 mesh. One thousand grams placed in the graduated cylinder measure just 1000 c.c. In this loose condition the material has a voidage of 63 per cent, and thus, though of higher specific gravity than the aggregate used in specimen "14b", its weight per cubic yard is but half that of the latter. Between the two extremes located at the ends of the curve, Fig. 1, lie a great field of mixtures with aggregates of different voidages and corresponding weights per cubic yard. Notwithstanding such wide variance in aggregate weights it is remarkable that when mixed with normal percentages of bitumen and compressed, the resulting surfaces weigh close to 100 lbs. per sq. yd. per inch of thickness. It is seldom that the difference is much in excess of 10 per cent above or below the weight. Some mixtures containing large stones or material of unusual specific gravity are exceptions.

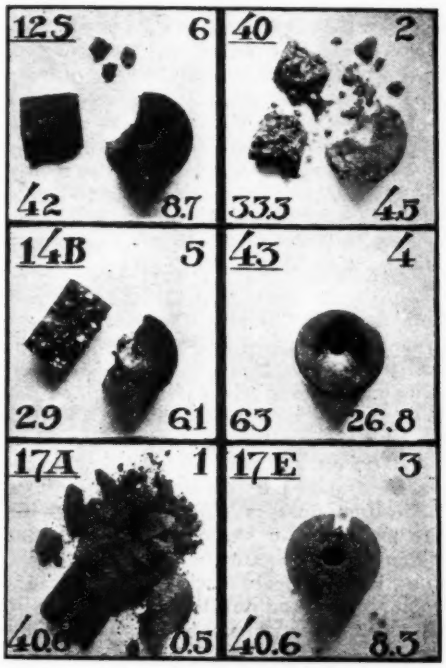


FIG. 4.

Test of blocks in order to show the influence of variations from "Normal Mix" as indicated by the Diagram, Fig. 1. The symbols in the upper left hand corners designate the specimen; those in the upper right, the number of blows; those in the lower left, the voidage of the aggregate; those in the lower right, the percentage of bitumen.

While the weights per sq. yd. may differ but little, the amount of bitumen depending upon the aggregate used, may vary within wide limits. With low voidage aggregates the bitumen by weight may be but one-fifteenth of the mixture, while with fine dust one-fifth of the mixture may be bitumen. When a finely divided sand or dust is mixed with a bituminous cement the material's bulk shrinks to a great extent so that as little as 22 sq. yds. of paving 1 in. thick may result from a cubic yard of aggregate. For coarser materials the shrinkage is less and, with very low voidage aggregates, as much as 31 sq. yds. 1 in. thick may be obtained per cubic yard of mineral aggregate. The right hand ordinates of the drawing, Fig. 1, furnishes a means of approximately estimating the amount of aggregate required to lay a given area of pavement. Specimen "43" has a surplus of bitumen, purposely so, in order to make a mastic that might be floated into place for special purposes. The extra bitumen increases the bulk of the resulting mixture over that of a "normal mix" so that instead of 22 sq. yds. per cu. yd. as shown by Fig. 1, 27 sq. yds. 1 in. thick may be covered, a square yard 1 in. thick weighing 89 lbs. containing 65 lbs. of mineral matter and 24 lbs. of bitumen.

Fallacy of Certain Theories Demonstrated

Specimens "17a" and "17e", Fig. 4, considered in conjunction with "43", illustrate the inapplicability of the "surface area of aggregate" and similar theories in determining the amount of bitumen that should be used. The material in "43", all passing the 200 mesh, is an impalpable powder. Its character is distinctly unlike that of material retained on the 200, the granular nature of the latter being plainly evident. Some theories assign huge and, in fact, indeterminate values to dust in bituminous mixtures because of the great area presented by the total of the tiny surfaces of the particles. On the other hand, the voidage diagram, Fig. 1, shows that 19 per cent, that is 235 grams of bitumen with 1000 grams of this fine mineral matter constitutes a normal mixture and thus affords a definite base from which to work.

The aggregate used in the blocks of series "17" is standard Ottawa sand, all passing the No. 20 sieve and retained on the No. 30. The grains are round and polished smooth. For most aggregates the minimum amount of bitumen that can be mixed therewith is not much below

the normal quantity. Ottawa sand, because of the absence of dust and the smooth surface of its grains, can be mixed with a very small quantity of bitumen. The surface area of aggregate theory applied to this sand indicates for its use in comparison with other known mixtures hardly more than a trace of bitumen. Accordingly, block "17a" was made with but 5 grams to 1000 grams of sand. Its disintegration under one blow proves

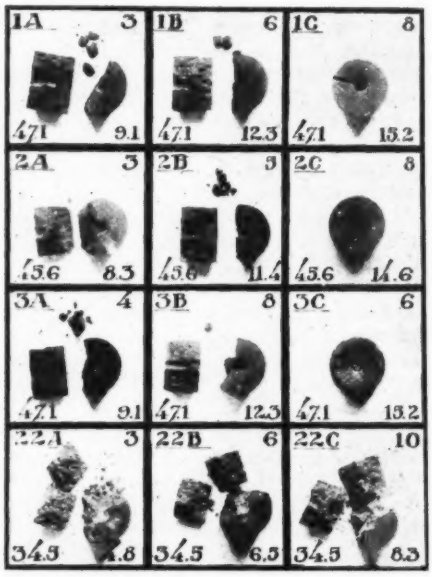


FIG. 5.
This group shows the comparative behavior of different aggregates with percentages of bitumen below normal and above. The aggregate in Series "1" is a sand, 100% passing a No. 10 sieve; for Series "2," 85% of this No. 10 sand is combined with 15% limestone dust and for Series "3," 70% with 30% dust. These three sets show that a "normal mix" is independent of the amount of fine material but is determined by the aggregate voidage. Series "22" aggregate is a combination of 15% Limestone dust and 85% quarter inch sand, about one-third of the latter being retained on the No. 10 mesh. It should be particularly noted that for this aggregate a surplus of bitumen does not make a soft mixture; that is, one which may be perforated by the pin.

the failure of the theory especially in comparison with block "17e" containing 90 grams of bitumen in accordance with the voidage diagram, Fig. 1.

It has long been assumed that the addition of dust to aggregates calls for an increase in bitumen. From tests one, two and three, Fig. 5, it is apparent that bitumen requirements depend upon voidage; and upon the presence or absence of certain sizes in the mineral matter, only as the voidage is affected thereby. A combination of 70 per cent sand with 30 per cent limestone dust may have the same percentage of voids as straight sand, and, therefore, the two aggregates may require the same amount of bitumen. Blocks are shown containing less than a normal amount and also a surplus of bitumen, the penetration being 50 units in each case. While voidage regulates bitumen requirements the character of the resulting mixture is seen to depend upon the quality of the aggregate itself. For instance, compare "1 b" and "3 b", "1 c" and "3 c", at the same time noting the number of blows. For comparison blocks of Series "22" are shown in order to illustrate an aggregate that resists the softening influence of an excess of bitumen. These blocks contain 85 per cent quarter inch sand mixed with 15 per cent limestone dust. This sand contains a large proportion of quarter inch pebbles, and it is interesting to note that in breaking the blocks, the pebbles are sheared apart showing that the full strength of the aggregate is developed by the mixture.

Determining Adaptability of Aggregates

The tests that have been described help to determine the adaptability of aggregates heretofore not used for bituminous purposes. Many natural sands are deficient in very fine particles which deficiency may be supplied by the addition of what is ordinarily known as filler. Portland cement may be used, but is expensive and not entirely satisfactory. Limestone dust is extensively used for the purpose. In exploring the possibilities of an aggregate the addition of dust must be considered both from the standpoint of cost and durability. In doing so it is well to make comparisons with some well known mixture. The standard aggregate in Washington costs approximately $2.65 per cu. yd. and is used with an average of 11.3 per cent bitumen. A cubic yard of aggregate lays about 28.5 sq. yds. of pavement 1 in. thick at a cost for the mixture of 20.6 cts. per sq. yd. per inch, weighing 100 lbs.

The specimens shown in Fig. 6 constitute a study of Potomac River sand, passing a ¼-in. mesh, combined with limestone dust, the quantity of the latter ranging from zero to 40 per cent. One idea being to develop an aggregate of little cost, it is necessary to use a practicable minimum of dust which costs $4.50 a cu. yd. while sand costs but 80 cts. per cu. yd. The photographs show an almost uniform increase in strength as limestone is increased up to and including 25 per cent. Above 40 per cent the

combined aggregate loses its sand character and assumes more that of a dust, the voidage of the combination increasing rapidly.

Potomac River quarter inch sand is not as constant a mixture as might be desired but the choice of a combination with approximately 20 per cent limestone dust has been found to be a conservative mean that allows for a good deal of variation in both the sand and dust under working conditions without materially affecting results. Comparing specimen "36" with others that have been shown, it is seen that a 20 per cent limestone dust combination promises exceptional durability, and with this percentage, a mixture is obtained at reasonable cost. The quarter inch sand is worth 80 cts. per cu. yd. weighing 2,800 lbs. Limestone dust, $4.50 per cu. yd. weighing 2,060 lbs. An 80% sand, 20% dust combination costs 1.94 per cu. yd. weighing 2,950 lbs. Seven per cent bitumen is used. A cubic yd. of aggregate lays 30 sq. yds. of pavement 1 in. thick. The cost for aggregate is 6.6 cts. and for 7.4 lbs. of bitumen, 7.4 cts.; a total of 14 cts. per sq. yd. 1 in. thick. If a surface on a street is to be laid to a depth of 1½ ins. this mixture affords a saving in materials of approximately 10 cts. per sq. yd. as compared to the cost of the topping now in use.

During the construction of pavements it is usual practice to take samples of mixtures from streets for the purpose of check analysis. In sifting the aggregates obtained from such samples cases have been found with but a trace of the dust originally used. Usually, more than 65% of limestone dust passes the 200 mesh. If a specified proportion is added to a known sand the percentage of the combination passing the 200 sieve may readily be computed, and any difference therefrom should be accounted for. Some mixing machines of the revolving drum type attached to direct heat dryers permit much of the dust to be blown out and lost. Even after the elimination of loss it has been found that sifting does not invariably discover all dust present. Microscopic examination shows that much dust may adhere to the larger particles of aggregate, thus causing a false granulometric determination.

The necessity of subjecting bituminous cements to rigid tests has long been recognized, but no tests have heretofore been commonly applied to determine the relative stability of mixtures as affected by the mineral matter employed. The variation in behavior of different aggregates when mixed with percentages of bitumen other than normal has been explained. It remains to illustrate the action of aggregates as influenced by the consistency of bitumen predetermined by the penertation test. Also the susceptibility to temperature changes of aggregates when mixed with normal amounts of bituminous cement.

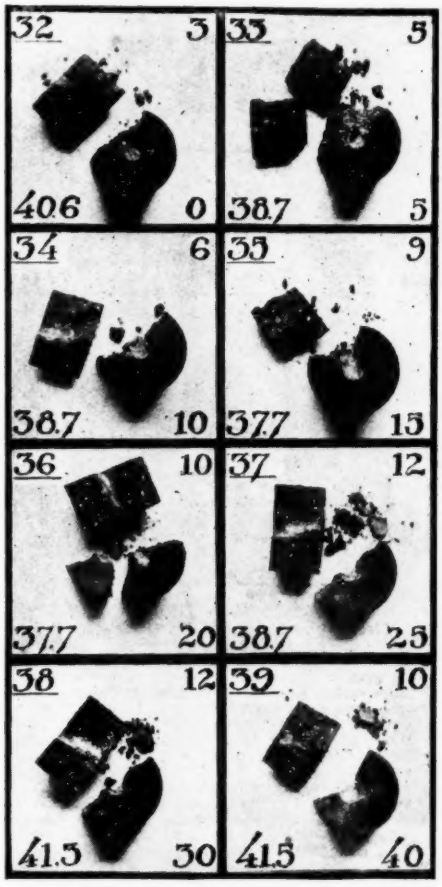


FIG. 6.
In these blocks the amount of limestone dust is varied from 0 to 40%, as shown by the figures in the lower right hand corners. Mixed with the limestone dust is quarter inch sand, the amount varying from 100% sand in specimen No. "32" to 60% in No. "39." The bitumen content is the same for all blocks, 7.4%. The figures in the lower left corners represent aggregate voidages. Those in the upper right the number of blows.

Three aggregates are shown in Fig. 7, each mixed with a normal amount of bitumen, the penetration varying from 15 units for the "A" Blocks to 90 for those marked "P." Series "23" blocks contain 85% quarter inch sand with 15% limestone dust. Series "25" are 100% No. 10

sand and those labeled "26" are 70% No. 10 sand, with 30% dust. Bituminous pavement mixtures have been variously classi-

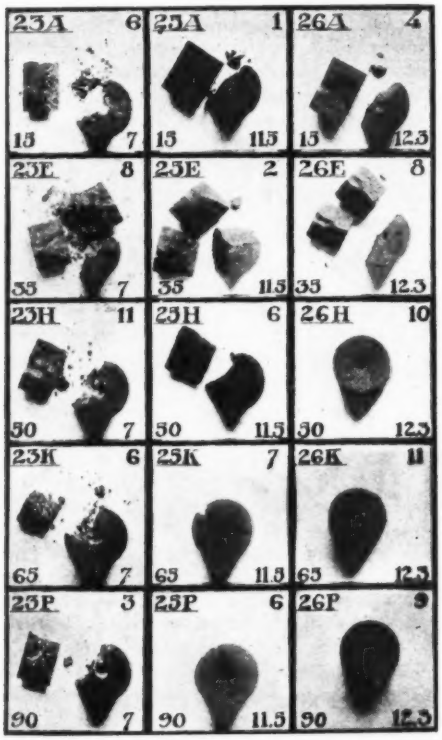


FIG. 7.

These photographs illustrate the relative effect of penetration on mixtures made from different aggregates. Upper left hand figures are specimen numbers; upper right, number of blows; lower left, penetrations; lower right, bitumen percentages. The aggregate for Series "23," voidage 35.6%, is a combination of 15% limestone dust and 85% quarter inch sand, about one-third of this sand being retained on the No. 10 sieve. Series "25," voidage 45.7%, is a sand, 100% passing the No. 10 mesh. Series "26," voidage 47.1%, is 70% No. 10 sand combined with 30% limestone dust.

fied in accordance with certain specified aggregate sieve analyses into four or five groups. Usually, and often without justification, a cement of higher penetration is called for with coarse materials than with fine ones. In view of the bitumen requirement diagram, Fig. 1, it is seen that division into three classes is logical; those mixtures having aggregate voidages of less than 40%, those with voidages between 40 and 50, and those above 50%. Particular penetrations should not be assigned for use with any one class, but should be determined experimentally to fit the needs of each case. For instance, with mixtures that call for small bitumen percentages usually high penetrations are specified, but from the photographs in Fig. 5 it may be seen that Series "23" aggregate with but 7% bitumen gives better results with a cement of less than 50 units penetration than above.

Temperature Effects

Since the temperature of the material in a street may vary from well below freezing to above 150° F., the less sensitive a paving mixture the better. It is well known that some pavements give good service in the winter but wave and push into bumps in the summer. The susceptibility as developed by the Block Test, comparing two aggregates, is shown in Fig. 8. Series "51" is 82% quarter inch sand with 18% limestone dust. The aggregate voidage is 36.5% and the bitumen percentage 6.7. Series "52" is a No. 10 sand and dust mixture similar to that used as a standard in Washington for a number of years past. The aggregate voidage is 44.6% and the bitumen percentage 11. As in other comparisons, so in the present one, it is seen that the quarter inch sand and dust combination stands out favorably. The strength of the mixture at low temperature is most remarkable. When heated to more than 130° F., the matrix loses some of its bind-

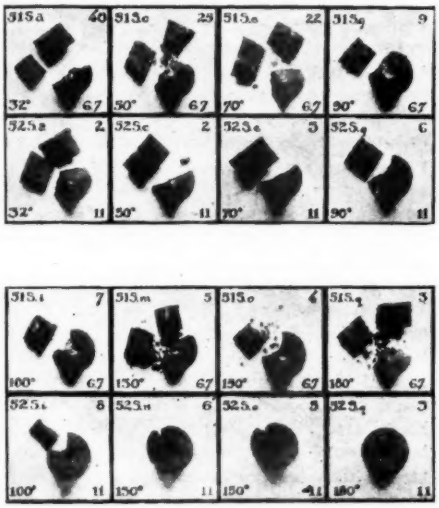


FIG. 8.

These specimens show the susceptibility of two aggregates to temperature changes. The Series "51S" blocks contain 82% quarter inch sand with 18% limestone dust, giving a voidage of 36.5%. Series "52S" contain the No. 10 sand and dust mixture that has been used as a standard in Washington for a number of years past, the aggregate voidage being 44.6%. The upper right hand figures record the number of blows; the lower left the temperature and the lower right the percentage of bitumen.

ing ability and the quarter inch pebbles in the plane of cleavage are not sheared apart. It would appear that this Series "51" mixture would serve better in a cold climate than in a warm one. However, reference should be made to the penetration test as illustrated by the blocks shown in Fig. 7, in which group appears an aggregate similar to No. "51." The temperature run was made with an asphalt cement testing 51 units penetration at 77° F., whereas Fig. 7 shows that the penetration might with good reason be reduced to as low as 35 units. Furthermore, it has been shown that variations in bitumen percentages greatly alter results obtained with aggregates. Thus there are in fact four elements; original aggregate, dust or filler, quantity of bitumen, and penetration of bitumen, an understanding of the significance of each of which is essential for the satisfactory control of bituminous design.

Practical Trials

After making aggregate surveys with block tests, as thus far described, it is essential to carry out practical trials. A territory such as the District of Columbia, making four or five hundred patches daily in its sheet asphalt streets, is in a particularly favorable position for the practical part of experimental work. Patching is of sufficient scope to afford a good service trial, and yet is of such a nature that if a particular mixture fails no great harm is done. In this manner information may be obtained as to the workability of a mixture both at the plant and on the street. A good idea may also be obtained as to the surface appearance; smooth, slippery, rough, or porous.

In Washington, after observing for some time the success in repair work of combinations of quarter inch sand and 15 to 20% dust, a street was recently surfaced with such a mixture. A location was chosen fronting a cement and steel warehouse, so that the pavement might be subjected to heavy traffic and afford a good test of the material. No binder course was used, the concrete base being laid 7½ ins. thick instead of the usual 6 ins. in order to provide for 1½ ins. of surface only. This experimental pavement was utilized for but a portion of the square, the remainder for comparison being the pavement which has long been a standard in Washington with 1½ ins. of binder and 1½ ins. of topping. The new mixture handled readily at the plant and on the street. It rolled nicely, giving a surface comparing well with that of the standard pavement. This construction and other sample surfaces to be laid are to be closely observed in order that their behavior may furnish a guide for future work. The proportions per batch were:

8	cu. ft. Sand	820 lbs.	76 %
2½	cu. ft. Dust	190 lbs.	17.5%
70	lbs. Bitumen	70 lbs.	6.5%
		1080 lbs.	100 %

In comparison with usual stipulations restricting aggregates for bituminous mixtures it is well to note the specifications governing the mineral matter in this experimental pavement, which were as follows:

SAND: The sand shall be equal to what is known as well graded quarter inch Potomac River concrete sand, clean and free from injurious soft particles or organic matter.

ITEMS	REINFORCED CONCRETE 3 inch Per Sq. Yd.		BITUMINOUS SURFACE 2 inch Per Sq. Yd.	
Sand	.041 cu. yd.	$.033	.059 cu. yd.	$ .047
Gravel	.062 cu. yd.	.074		
Portland Cement	.145 bbl.	.375		
Tar Coat (in place)		.035		
Reinforcing @ .022 per sq. ft.	9 sq. ft.	.198		
Limestone Dust			38 lbs.	.085
Asphalt Cement			14 lbs.	.140
Material Total		$ .715		$ .272
Operations on street		.10		.08
Plant charges and operation		.12		.27
Hauling @ 70c. per ton	390 lbs.	.136	215 lbs.	.077
Total Operating		.356		.427
Operating and Material, Total		$1.061		$ .699
10% Overhead—10% Contingencies		.212		.140
Contractor's Profit		.197		.136
Total per sq. yd.		$1.470		$ .975

DUST: Limestone dust shall be used, 85 per cent passing a 100 mesh screen.

Proper Exploitation of Local Cheap Materials

The proper exploitation of local cheap materials has a value not generally realized. During late years gravel and sand have been developed to some extent for bituminous mixtures. Usually, however, so many restrictions are placed on the aggregate grading that much screening and blending of sizes are made necessary. The mental attitude of a contractor is affected by the involved specifications, which is reflected in the bidding. In a recent competition for a topping to be placed on a concrete road in a western state, a 2 in. bituminous surface lost in favor of a 3 in. hydraulic cement concrete of 1-2-3 mix. The losing bid per sq. yd. was 60% higher than that for the 3-in. concrete, the latter including a tar paint coat for the old road and 28 lbs. of reinforcing per 100 sq. ft.

Based on Washington conditions and the use of a quarter inch sand asphaltic mixture, it is of interest to analyze this situation comparing data relative to the two constructions as tabulated on the bottom of page 131.

This tabulation shows that a 2-in. bituminous surface may be constructed for 33% less than a 3-in. reinforced concrete one. This result is markedly different from the indication in the actual bids mentioned above, that the latter surface would cost 60% more than the former. In the account as recently published of the first series of investigations carried out in the District the conclusion was reached that a concrete base is well justified for a new bituminous pavement. To complement this conclusion it may be stated that when a top is required a bituminous surface is equally warranted for an old concrete pavement.

Utilizing Old Waterbound Macadam

In the District of Columbia there are 150 miles of original waterbound macadam roads. While probably no more pavement of this type will be constructed, the proper conservation of that now in place has become much of a problem. About 10 cts. per sq. yd. is being spent in treating most of these macadam roads with oil or tar and screenings which is exclusive of expenditures for general repairs necessary to bring the macadam to first class shape prior to the surface treatment. A road thus renewed and oiled and similarly treated periodically gives fair service, its yearly maintenance depending greatly upon the traffic to which it is subjected. In any event, annual expenditures are several times as much as for asphalt streets and, under heavy traffic, these roads cost many times as much as asphalt under like conditions.

In order to utilize old macadam under exceptionally severe traffic, various bituminous surfaces have been constructed thereon, and in a few cases our standard sheet asphalt. The application of this latter is unsatisfactory. Being 3 ins. thick, it necessitates some dressing down of the old road in order to give a practicable grade and cross section, and, even then, results in an abnormal crown and little or no curb display. The original cost of sheet asphalt, consisting of a binder course and topping, is large, and such an outlay generally proves improvident when used to cover the uncertainties and hazards existing in old macadam streets.

The use of the quarter inch sand mixture previously discussed herein, together with the elimination of the binder course, presents a proposition unusually attractive. It has been shown that this surface can be laid for approximately 50 cts. per sq. yd. per inch of thickness. An inch and a half covering should give economical and satisfactory results. This depth may be thinned to 1 in. on the sides of the road along the curb. In order to give construction of this nature a service test a section of waterbound macadam was chosen several squares in length. So that a positive determination could be made, a portion of the street, for comparison, was surfaced with a bituminous macadam.

The old road, repaired and brought to a good shape with new stone and screenings, was opened to traffic for three weeks prior to construction of the new surfaces. During this period it was sprinkled twice daily. The portion to be topped with the quarter inch sand mixture was divided into two sections, one simply being well broomed just prior to receiving the surface, the other being sprayed with a light tar, about ¼ gal. per sq. yd. This treatment was given the day before laying the hot mixture in order that the tar might have time to soak into the street. The portion covered with bituminous macadam was thoroughly swept prior to being surfaced. Thus there are three sections available for comparisons; a 1½ in. sheet asphalt laid on a macadam road, a similar construction, the macadam having just been dressed with a light tar, and third, a 3-in. bituminous surface on the existing road laid in accordance with

usual specifications for penetration macadam.

For this latter construction the stone used averaged 2,500 lbs. per cu. yd. and cost, delivered at the city's railroad yard, $2.88 per ton. Fine material for the seal coat cost $1.08 per ton. It might be noted that the freight on a cubic yard of stone is 45 cts. more than the entire cost of a cubic yard of quarter inch sand F. O. B. the city's wharf. Tar used for binding the stone cost approximately 16 cts. per gallon in place. The cost of the penetration macadam may be itemized as follows:

3-in. Penetration Macadam—Cost Per Sq. Yd.

ITEM	AMOUNT per Sq. Yd.	COST per Sq. Yd.	
2½-inch stone @ $2.88 per ton	230 lbs.	$0.33	
1 -inch stone @ 2.88 per ton	40 lbs.	.057	
Screenings @ 1.08 per ton	30 lbs.	.043	
Hauling @ 70c per ton (300 lbs. of stone)		.105	
Spreading stone and screenings		.045	
Rolling		.030	
2¼ gals. tar @ 16c in place		.360	
Total operating and material			$0.97
5% contingencies—10% overhead			.15
Contractor's profit			.15
Total per sq. yd.			$1.27

A one and a half inch surface using a hot mixture with quarter inch Potomac sand can be laid for 75 cts. as compared to $1.27 for a 3 in. penetration construction. The thinner surface, not execessively raising grades, is, of the two, better adapted for topping existing old roads. Not only is there advantage from the standpoint of primary engineering and economy but also the inch and a half sheet asphalt renders better service and costs less for maintenance.

Conclusions Independent of Location

While the comparisons that have been made herein of different surfaces are upon conditions existing in the city of Washington, the conclusions reached are to a great extent independent of locality since the economy shown is largely one of material quantities. The saving that appears in favor of a premixed surface can be realized only when the work is not enveloped by such a haze of specification requirements as to confuse the contractor. With the design of bituminous pavements on a workable basis, it is not necessary to place dependence upon misleading granulometric formulae. Certain mesh combinations of aggregates in one locality mixed with a definite amount of bitumen may give a satisfactory pavement. The same combinations made up in a different locality may give a most unsatisfactory mixture. Due to the uncertainties in such work, it has been common practice to require contractors to guarantee their construction for periods of from one to five years. Why should the responsibility be placed on the contractor when the engineer specified the work and design down to the minutest detail? It is unnecessary to blend materials so as to conform to certain well known or patented formulae. An aggregate that is used with success in Portland cement concrete may be handled with assurance in bituminous mixtures.

Procedure in Selecting Proper Aggregate

It is thus apparent that there are a number of variables to be properly controlled if successful bituminous design is to be achieved. The cost is, of course, a vital consideration and any good pavement must not only render efficient service, but its cost must be within reason. With the understanding that due weight is given to the cost factor, the following would be the procedure in selecting the proper aggregate: The "normal mix," diagram, Fig. 1, enables the quantity of bitumen to be determined for any aggregate. The block test then shows the probable behavior of the mixture made with this aggregate and determines whether or not it will be satisfactory for use as paving material. This simple block test enables us to vary the composition of the aggregate by the addition of filler or dust and shows to what extent the mixture may be affected by changes in the penetration of the asphalt cement. It further shows the behavior of the mixture under temperature changes. The object of all of these tests is to obtain a paving mixture, economical in first cost, economical as to annual maintenance, and one that will render satisfactory service under the actual traffic to which it will be subjected.

REPORT OF PRESIDENT HARDING'S CONFERENCE COMMITTEE ON MUNICIPAL ORGANIZATION TO HANDLE UNEMPLOYMENT EMERGENCY

(Editor's Note: Every responsible public official should read and act on the recommendations contained in this committee report to the extent of his resources and abilities. He is relieved of the responsibility of making the decision to act [that decision has been made at Washington for the nation], but it is his responsibility to act on the decision so made. Briefly stated, this report points the way to a nation-wide municipal drive against unemployment. It will solve the local employment problem wherever acted upon and, if followed throughout the country, will solve the national unemployment problem. It will be noted from the committee roster, given below, that men on the committee are familiar with state, municipal and county public improvement work and know what they are talking about.)

It is Up to Local Communities

Cities and towns must be relied upon for immediate attack upon the emergency created by unemployment. Whatever is done must take place in local communities and the citizens of such communities are the ones responsible and capable of seeing that the necessary measures are carried out. This but repeats the first principle of American public life, reliance upon local initiative and obligation.

The mayors of cities are the natural and authorized leaders and directors of their communities for all emergencies affecting the public welfare. In the present crisis the mayor should head the effort of each locality and organize the most influential and representative citizens and agencies to handle the local situation.

Mayors and Governors Should Lead

In the interest of speed, order and effectiveness the chief official of each community should immediately marshal all its resources. The mayor and his organization should furnish such leadership as will enlist the support and utilize the services of all.

The governor of each state as the superior officer of all local officials is urged to call emphatically to the attention of communities and mayors their peculiar responsibility and fitness for handling this unemployment situation.

The methods of accomplishing results must vary with each locality, and no methods capable of universal adoption can with safety be recommended. Therefore specific recommendations to communities are confined to the very urgent one that following the leadership of their mayors with united local committees they accept this primary obligation to the full.

General Guiding Principles Based on Past Experience

However, the following suggestions or general principles based on past experience are respectfully offered to such communities:

1. The Mayor's Committee should try to harmonize the operation of all the different agencies which are trying to relieve the situation, so as to avoid clashing and wasted effort.

2. The facts of the extent and distribution of unemployment should be in the possession of the committee and should be made available to the public.

3. Each locality should have a public employment bureau.

4. The Mayor's Committee should try to get the whole community behind the effort to speed up the construction of public improvements. In a period like this there should be the greatest activity in putting up new schools and other needed public buildings, and in necessary repairs and improvements in streets, bridges, sewerage, public utilities, parks and other municipal works.

5. Every effort should be made to provide real work by stimulating industry. Meanwhile each industry should be urged as far as possible to keep together its own force by giving at least part time employment.

6. In some cities "Spruce-Up" campaigns have proved good. In these every one is urged to do at once whatever is needed in the line of sprucing up his property. This applies both to public and private owners of property, to small householders and flat renters as well as to large companies, hotels, theaters, etc. It should be made clear to all that money spent in this way, stimulating the regular activities of industry, will help to reduce unemployment far more than any other aid.

7. It is important to strengthen and increase the resources of the local family welfare agencies which are best prepared for effective service, and to give them vigorous support in order that they may deal promptly and adequately with the needs of families and individuals. The burden of meeting these needs should be borne, not by a selected few, but by many.

Provision should be made for maintaining the usual facilities for the homeless, and for the relief of poverty arising from sickness, from widowhood, from mental or physical handicaps, in order that these may not be a complicating factor in the problem of unemployment. Cities that have municipal lodging houses or other adequate provision for the homeless man find that this makes possible differentiating the two problems of the resident and floating unemployed, and enforcing regulation against vagrancy and begging.

8. Consideration should be given to the practicability of keeping children in school as long as possible in order that they may not compete for the insufficient number of jobs and also that they may profit by additional schooling and the postponement of the beginning of wage-earning. It may be found desirable to give scholarships to minors beyond the compulsory school age, and the public schools have provided special vocational training for them so that the period of unemployment may be used to equip them for better positions.

9. It must always be remembered that an unemployed person needs work, first and last, and that the community should relax no effort to find work for him, regarding other aid only as a temporary measure to be superseded at the earliest possible moment by work. The community should be able to handle the situation in such a way as to make bread lines unnecessary. Each community should remember that hunger and want must be relieved, and it should always be prepared to take whatever measures may be needed to prevent human suffering.

10. We suggest that each city avail itself of the experience of others. The methods of Detroit, Boston, Philadelphia, Milwaukee and New York have been brought to the attention of the conference, and we are certain that the mayors of these and other cities will be glad to answer inquiries.

The report is unanimous. Col. Arthur Woods of New York is chairman of the committee and the following are the other members: Charles M. Babcock, St. Paul, Minn.; Bird S. Coler, New York City; James Couzens, Detroit, Mich.; Bascom Little, Cleveland, Ohio; Andrew J. Peters, Boston, Mass.; Ida M. Tarbell, New York City; Ernest T. Trigg, Philadelphia, Pa.; Matthew Woll, Washington, D. C.; G. E. Haynes, Washington, D. C.

A FRIEND OF THE FARMER TAKES US TO TASK

To the Editor:

I am in receipt of your circular letter enclosing clipping from Municipal and County Engineering. (Reference is made to a reprint of the editorial entitled: Building or Breadlines, published in the September, 1921, issue.—Editor.)

Referring thereto, let me call your attention to farming, the industry, the largest buying power in the world, which you and those you represent, helped down and are now keeping down in the interest of economy.

How do you expect any money in circulation in the corn belt, which embraces five states, with the price of corn at 35c and oats at 15c? You can "Legislate" and "Resolve" and send out propaganda for the next ten years and the situation will not improve. You asked the farmer to set the example, but you did not keep your promise and follow. Now, instead of keeping him down, help pull him out of the mire and you will see work and business start immediately. He is the biggest buyer of labor, for he buys every material and product of labor. The farmer, nor anyone else, for that matter, that knows anything about progressive economy, will demand a cheap or low priced industrial system. It is better for the welfare of the country that prices maintain a fairly increased level. It stimulates business and industry and is an incentive to labor to earn and each individual's prosperity is then wholly dependent upon his ability to save.

Very truly yours,

JOHN A. GOODWIN,
Investments, Real Estate, Law, Insurance, Loans, Etc.,
203 North Street,
Normal, Illinois.

Sept. 28, 1921.

(Editor's Note: Mr.Goodwin's letter is most welcome because it states a view widely entertained in the agricultural districts and because it illustrates the fact that we are living in "an era of mutual suspicion and distrust," so we gladly embrace the opportunity to make a few observations on the points raised, in our own behalf and that of "those we represent."

Now what are the facts? In the first place let it be said that the farmer's notion that every city man's hand is set against him is a nightmare and nothing more. Agriculture is the mother of us all

and every city man who is worth two pins not only recognizes this fact but finds much pleasure in admitting it. We are not thankless children and have no thought of denying our mother agriculture. The Construction Industry is very proud of its position as the second among American industries, second only to Agriculture. To be second only to Agriculture, is, of course, to lead all the rest and that is quite enough. We doubt if any American wants any industry to take the leadership from Agriculture. At any rate this is an impertinence of which the Construction Industry is incapable.

We see no justification for the statement that "we" and "those we represent," helped farming down and are now keeping it down in the interest of economy.

Let us take the "we" part first. (It should really be spelled "wee" because it is so small.) Would it surprise you greatly, Mr. Goodwin, to learn that the editor of this magazine was born and reared on an Illinois farm, that his furrow often broke the "stubborn glebe," that he knows what it means "to meet the sun upon the upland lawn," and that his father, and only brother still live on the old homestead? Such is the case, unimportant in itself, you will say, and right you are, but important as an illustration of the fact that the majority of city dwellers either came direct from the farm or are but one or two generations removed from it. The cities are not peopled with one race of men and the farms with another; the city man and the farmer are blood brothers and when the farmer is not prosperous the city man is unhappy and, moreover, is usually anything but prosperous. No, the assumption that the city man "helped the farmer down" will not hold, not in this day and generation.

Not long ago we were talking with an elderly gentleman who has been a leader in the Construction Industry for many years and he deplored the farmer's present position, saying the rest of us could not hope to profit greatly while the farmer is not prosperous. This is generally understood and is a basic economic truth. The Construction Industry, and every other industry, would be very happy to see the farmers again prosperous, for selfish as well as sentimental reasons.

Our editorial, which prompted our correspondent's letter, had nothing to do with the imaginary case of the farmer against his relative in the city. We were not dealing with theories, economic or otherwise, but with two facts recognized by everybody from the President of the United States down to the editor of this modest professional journal, namely: the unemployed now number fully 6,000,000 men and winter is coming on. We advocated, and still advocate, and shall keep on advocating the launching of long delayed public improvement projects as a means of providing useful work for those who are now idle. This is an old, old method of coping with unemployment. It has been used many times during past depressions. Obviously, it will not help the farmer to have men idle, in the cities, who must subsist on public charity before another spring unless work is found for them to do. We advocate a time-tried procedure which our position has naturally brought to our attention and understanding.

In this issue we publish a letter from a correspondent in Decatur, Ill., who tells us that his city is now doing the various things we propose. If we remember the geography of our native state, and we think we do, Decatur is not for from Normal and both are in the corn belt, which region, we stoutly maintain, is the present day Garden of Eden. What is good for Decatur is good for Normal, too.

The editor is not an economist, either of the long or short-haired variety. But one or two things seem so plain we should all agree on them. First, the present depression is world wide. It is worse in every other country than it is in ours. The export trade is "flat" and the farmer can't sell his surplus over domestic requirements. This is merely the cold, grey morning after the debauch of the greatest war in history. Second, it is certainly better for the farmer to have city people busy and able to buy than to have millions of them idle and subsisting only by grace of breadlines and soup kitchens administered by the tight hand of charity.)

WILKINSBURG, PA., MODERNIZES 29-YEAR-OLD BRICK PAVEMENT

By Charles F. Snerling, Borough Engineer, Wilkinsburg, Pa.

What is perhaps one of the most economically constructed stretches of street improvement on the entire Lincoln Highway, particularly when considered from the standpoint of durability and the service it will render traffic in years to come, has just been completed on Penn Avenue in the Borough of Wilkinsburg, Pennsylvania. It is of vitrified brick and cost only $1.93 per sq. yd.

The story, to be rightly told, must start back in 1892, when the original pavement was laid. At that time there was no knowledge of swiftly moving automobiles and heavily laden motor trucks which later were to grow to such numbers as to create our modern traffic and attendant paving problems.

There were a few requirements, however, which determined the type of paving to be placed on Penn Avenue 29 years ago which hold equal importance today. In the first place the street is abutted on one side by a railroad siding. This meant that heavy wagons transferring freight would use the thoroughfare. A durable pavement was therefore essential.

The Original Pavement

The following construction was adopted: An 8-in. two-course rolled stone and gravel base, 2-in. sand cushion and a 4-in. vitrified brick wearing surface.

For 25 years this pavement stood up without a sign of impairment. Then during the war, when an added burden was thrown on the highways, this particular street got more than its share. Army trucks and commercial trucks, heavily laden, used it summer and winter.

Despite this increased traffic, both in number and in weight of vehicles, a condition which the designers of the road never expected it would have to undergo, the principal apparent effects were slight local base settlements. This resulted from the heavy traffic further compacting the base. It settled in spots where the base had not been as thoroughly compacted as it might have been at the time of construction.

Because of the fact that the heavy traffic caused the old base to settle, and because we realized that in years to come this main thoroughfare would be called upon to carry increasingly heavy traffic, it was decided to strengthen it this summer, still adhering to the original type of construction as to base and wearing surface, because both had justified themselves in the 29 years of service.

When the old brick were taken up we found in several places, to the length of 100 ft. and about 4 ft. wide, several stretches of no other foundation than river sand. In my opinion this was placed there originally contrary to specifications, and I speak of it because the sand seemed to support the surface equally well with the old stone and gravel base which was supposed to underlie the entire surface.

The Reconstructed Pavement

In the reconstruction we made good use of the old foundation. After rolling it several times thoroughly to compact it, we spread over it about 6 ins. of granulated slag, of which a cheap supply was available locally. This we rolled down to a thickness of about 3 ins. The slag was then thoroughly sprinkled with water and rolled again, shaped to grade, and rerolled until it presented a perfect base. We used a 5-ton gasoline tandem roller.

On this newly strengthened base we laid, directly upon the granulated slag as consolidated, a 3-in. vitrified brick wearing surface. We then rolled the brick surface with the 5-ton roller and lastly applied a filler of asphalt according to the specifications of the National Paving Brick Manufacturers' Association.

In conclusion I want to say that the cost of $1.93 per square yard does not include any salvage on the old brick. These we are going to use in paving the bottom of our culverts, of which we have a mile or two in the borough.

SEWER CONSTRUCTION IN DETROIT, MICHIGAN

By F. F. Griswold, Pressed Steel Dept., Truscon Steel Co., Youngstown, Ohio

Several years ago the City of Detroit annexed a great deal of property lying north of Highland Park and Hamtramck. Drainage of this property was necessary, and considering the rapid growth of Detroit in the past few years it seemed quite likely that these sections would soon be built up. For that reason the Department of Public Works has been putting in the storm water sewers.

The total Detroit sewer projects as originally drawn up totaled some thirty-three million dollars, and of this amount contracts have been let for approximately twenty million, leaving thirteen million dollars of contracts yet to be let. These are being let at the rate of about 1¼ million per month.

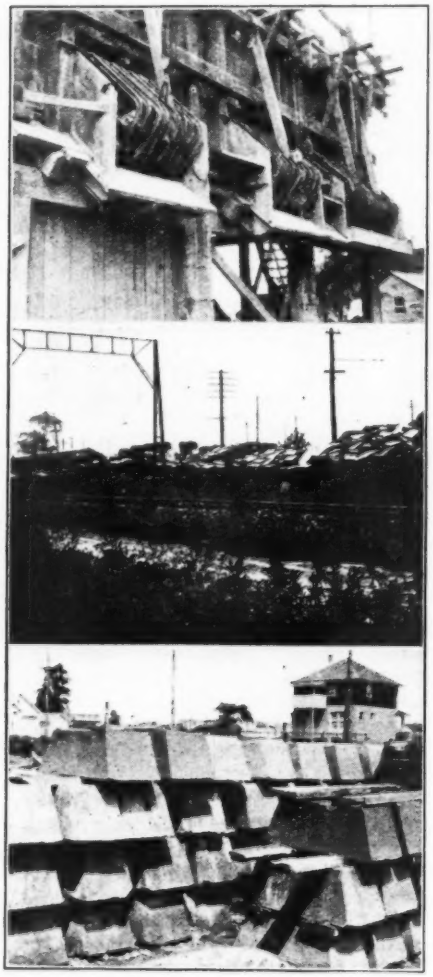
The type of soil through which sewers are being constructed is ideal. It is practically all high grade blue clay. This clay starts, in most instances, about 10 to 15 ft. below the surface, and tests which have been made have found it to extend down 250 ft. to 300 ft. and further.

The Bates Street Sewer

One section of the Bates Street sewer is being constructed by Booth & Flynn, General Contractors, Pittsburgh and New York. It is some 3,000 ft. long and is 13 ft. 6 ins. inside diameter. The walls are

concrete and are 16 ins. thick. This is one of the three new relief sewers in the center of the city.

In the south end of this sewer the ground is quite sandy and wet in places, and it is necessary to construct the sewer



VIEWS OF SEWER CONSTRUCTION

View of Muck Handling Hoppers Used on Large Jobs—Truscon Tunnel Liner Plates for Use in Gratiot Ave. Sewer—Concrete Blocks Used in Connection with Truscon Form on Livernois Road Sewer.

under air. In some places the roof of the sewer is only about 11 ft. from the street surface, and for that reason a heavy air pressure cannot be maintained, as there would be a possibility of blowing up the street. The pressure is maintained at about 6 pounds per square inch, which is sufficient to keep back the water.

Working Under Air Pressure

In order to work the sewer under air it is necessary to build two bulk heads in the sewer near the shaft. These bulk heads are about 30 ft. apart and are made of concrete poured integral with the walls of the sewer. A square hole is left at the bottom just large enough for a loaded car to pass through. Heavy steel doors are swung on hinges on each bulk head. These bulk heads form a chamber in which the air can be equalized, thus allowing cars to pass through the tunnel while maintaining air pressure. For example, when a car comes down the shaft to go to the head of the tunnel it is necessary to open a valve in the outside bulk head, which allows the air in the chamber to equalize with atmospheric pressure. When the pressure has been equalized the door is opened and the car pushed into the chamber. The door is closed and also the outside valve. Now the inside valve is opened and the pressure in the chamber is equalized to that within the sewer, thus allowing the inside steel door to open and the car to go on through.

The Mining

On the night gang there is a "Miner" who digs a hole just large enough to work in and to the depth required in the next day's digging. This makes a place for the men on the day gang to work in when they start to work. One or two men will go into the hole and dig it out until it is large enough for several men. They dig on the sides and roof first so that the roof is finished ahead of the rest of the sewer. At the same time the floor of the sewer will be dug out to a little below the spring line. When the digging has progressed to this point the Needle Beam is put in place and lined up. The Needle Beam is a heavy I-beam about 4 ft. longer than the length of sewer to be dug each day. It is used to line up grade and center line. One end of the Needle Beam rests on a ledge in the far end of the tunnel and the other end is blocked up and wedged with a bearing on the concrete which was poured the night before. With the Needle Beam in place and the roof held firmly by jacks, one end of which is braced against the Needle Beam and the other against tunnel liner plates, the digging continues until the necessary amount of dirt has been removed, and the outside diameter is correct. The section of the sewer is then ready for setting forms.

Two Ways of Setting Forms for Concreting

The forms for concreting are lined up in two ways. The first of these, and the way which is generally used in the large diameter sewers, is by means of the Needle Beam. The cross-bracing of the ribs of the form is so spaced that when resting on the top of the Needle Beam the ribs will be in correct alignment as regards grade. The spacers between the ribs of the forms will keep them in line and as the Needle Beam has already been set up as to grade, the setting up of the form is very simple.

The Needle Beam is already under pressure on top, due to the fact that jacks are working from it against the tunnel liner plates used in the roof, therefore it is possible to put one or two jacks in position against the under side of the Needle Beam and against the ribs of the steel form to hold it in place and keep it from floating when the concrete is being poured.

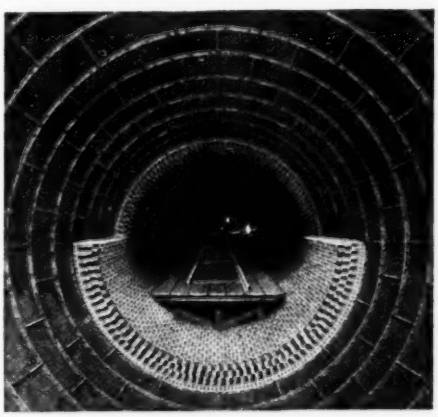
The second way of setting up forms is by means of concrete blocks. These blocks are pre-cast and have set before being used. When the forms are ready to be placed several of these blocks are put in position and lined up as to grade and center line. The ribs of the forms are then built up on these concrete blocks. Bracing is accomplished by means of jacks, which hold the ribs against the concrete blocks, and also by means of blocking from the top of the rib to the roof of the tunnel.

As soon as the ribs are in place the plates are put on up to the spring line. The row of plates nearest the concrete which was poured the day before, or, in other words, the row of plates which would be handiest to the car of concrete as it comes to the head of the sewer, are not put in until the concrete is up to the edge of them. The plate is then put in and the concrete shovelled up over the plates. They begin to pour the concrete just as soon as the lower plates are in place, and as the concrete fills up the side more plates are put on. By this method it is not necessary to lift the concrete as high as it would be were the plates put on up to the top at one time. When the top of the sewer is reached key plates are slipped into place and the concrete shovelled up onto them a little bit at a time and pushed back into place with a hoe. This is probably the slowest and hardest part of the job.

Placing the Forms

In placing these forms the ribs are first put in position, lined up and spaced. These ribs are formed of heavy channel of sufficient strength to withstand whatever pressure is required of them. The ribs are made up in two, three or four sections to a circle, depending upon the style, construction and the size of the sewer. Gusset plates are fitted to the ends of the channel, one on each opposite leg of the channel; in other words, one separate plate is riveted solid to one leg of channel A, while another gusset plate is fastened solid to the opposite leg of Channel B, thus when they come together they can be slid into place by one another and then bolted securely. Where conditions make it necessary there is also special reinforcing from the gusset plate fastener to the center beam and from there to the gusset plate on the lower side.

The plates used for covering the ribs are of various sizes, depending upon the diameter of the sewer. They are generally 3 ft. in length and 18 ins. to 36 ins.



TRUSCON TUNNEL LINER PLATES, SEVEN-MILE ROAD AND GRATIOT AVE. SEWERS, DETROIT, MICH.
Outside Diameter of Sewers—12 Ft. to 13 Ft. 8 Ins.

in circumferential width. At the top of the forms there are plates which are called "Key" plates, which are small and easy to handle. These are placed in one at a time as the concrete is filled in between the form and the roof.

It takes about 5 hours to pour 12 ft. to 15 ft. each night, and this concrete has set sufficient by the next night to make possible moving the forms up to the next position.

All Detroit sewer work is under direction of Mr. C. W. Hubbel, Chief Engineer, and Mr. Sears, Superintendent. Fred Legg is chief inspector, having assistants on each separate job.

NEW COMPLETE STREET LIGHTING SYSTEM FOR KANSAS CITY, MO.

Kansas City, Mo., will be one of the first cities in the country to adopt a uniform system of modern ornamental street lighting illumination on a large scale; and incidentally this improvement will mean displacing 2,000 gas posts with which the residential section of the city is now lighted, as well as a number of electric lights of the cluster and overhead pendent type.

The city has just contracted with the Kansas City Light and Power Company for the installation of approximately 7,000 lamps in Novalux units, and it is expected that by the time they are installed the

TYPICAL STREET LIGHTING FIXTURES FOR KANSAS CITY, MO.

Left: Form 8, General Electric Novalux Fixture with Alabaster Rippled Glass Globe—Right: Form 16, G. E. Novalux, Equipped with No. 97 Diffusion Globe and Metal Canopy.

number will be doubled in order to keep step with the progress of the city, the residential districts of which are rapidly expanding. An initial order for 2,000 Novalux units has already been placed with the General Electric Company, and additional ones will follow as the work progresses.

Some years ago there arose in Kansas City a demand for ornamental street lighting. The business district is pretty well covered by street car lines, and therefore it was decided to utilize the trolley wire standards for holding the lamps. A cluster of four globes, each containing a 100-watt multiple lamp, was placed on each standard. Approximately 1,200 trolley poles were equipped in this way, the whole constituting what was called the Bright Way Lighting System.

Outside the business district, and between it and the residential sections, there is a small zone which for a number of years has been lighted by four-ampere magnetite arc lamps of the pendent type and G-E Form 6 Novalux fixtures equipped with 600 candle power lamps and band refractors. The residential section has for years been lighted entirely by gas posts, using several thousands of gas lamps.

The recognized inefficiency of the cluster lighting, together with the poor results obtained from the gas lamps, resulted in a popular demand for better street lighting.

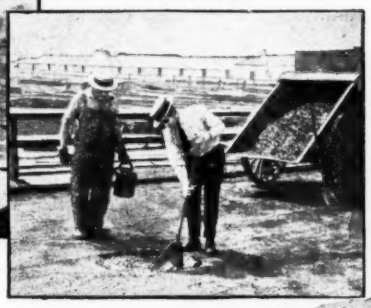
The Chamber of Commerce took up the matter and started an agitation for correcting this condition. A "Get it Done" committee was appointed, and after various reports on the subject had been made, the city, the Chamber of Commerce and the Kansas City Light and Power Company united their forces to give the city a modern street lighting system. The result is the new installation authorized and just announced.

The cluster lamps now in use on the trolley poles will be replaced by an ornamental bracket supporting a Form 8 Novalux unit with alabaster rippled globe and metal canopy.

The gas posts will be supplanted by iron standards of Flemish pattern which were designed by the Illuminating Laboratory of the General Electric Company and will be manufactured by the King Manufacturing Company of St. Joseph, Mo. These will be equipped with G-E Form 16 Novalux units, some of which will be furnished with No. 107 alabaster rippled globes and metal canopies, and others with the No. 97 diffusing globe and metal canopy. The alabaster rippled globes are of clear glass, rippled, with a flashing of opal. The ripple gives life to the "dead" light—i. e., the light from an incandescent lamp as contrasted with that of a luminous arc—and the opal gives diffusion. All of these fixtures are to be equipped with 400 and 600 c. p. lamps, the majority using the latter size.

All of the units will be of the IL transformer type for safety-first reasons, making it impossible for anyone to be injured in replacing lamps, cleaning glassware, etc. The lighting company plans to maintain the new system in the very best condition and is having constructed a motor truck which will be used exclusively in cleaning the glassware of the lamps.

"Tarvia-KP" and stone are turned over by hand until all stones are coated. Then sand is added.



The hole to be patched is cleaned out and the bottom and sides are painted with "Tarvia-KP."

The mixture of "Tarvia-KP," stone and sand is put in the prepared hole.

A Patch in Time Saves Many a Road—

NOW is the time to fortify your roads against the ravages of winter. Patch the surface breaks, fill the depressions—have your streets and highways in ship-shape condition before the first snowfall.

For winter, with its alternate freezing and thawing will ruin a road, whereas a *little* care *now* may mean a vast saving in actual dollars later on.

"Tarvia-KP" has an astonishing variety of uses. It is employed in patching macadam, asphalt, bituminous-concrete and cement-concrete roads.

"Tarvia-KP" is a material that can be used for patching at any time of the year—it is as serviceable in winter as in summer, for freezing does not injure it. A batch of the mix can be made today and used weeks hence—in fact, aging improves it.

"Tarvia-KP" makes a smooth, perfectly bonded patch—a patch that becomes an integral part of the road itself. A patch that is durable.

There is only one "KP" and that is "Tarvia-KP" patching material made by The Barrett Company.

Our nearest office will gladly send you an illustrated manual of instructions showing each step in patching a road with "Tarvia-KP."

The mixture is well tamped and covered with screenings.

A seal-coat of ½ gallon of "Tarvia-KP" to the square yard is spread over the patch.

Screenings are scattered over the seal-coat and the patch is again tamped.

Tarvia-KP

FOR COLD PATCHING

New York Detroit Salt Lake City Johnstown Elizabeth — Chicago New Orleans Seattle Lebanon Buffalo — Philadelphia Birmingham Peoria Youngstown Baltimore — Boston Kansas City Atlanta Toledo Omaha

The Barrett Company

St. Louis Minneapolis Duluth Columbus Houston — Cleveland Dallas Milwaukee Richmond Denver — Cincinnati Nashville Bangor Latrobe Jacksonville — Pittsburgh Syracuse Washington Bethlehem

THE BARRETT COMPANY, Limited — Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S.

Authority was given the mayor of the city by the City Council to enter into a new contract with the company, and this contract is pronounced one of the best of the kind ever written. Requests for copies of it have been received by the company from all over the country.

The following is a partial description of the number and types of lamps to be used in the new installation according to the terms of the contract.

The present bright way street lights will be replaced by 952,600 c. p. Mazda series lamps with Novalux units in the downtown district and 300, 400 c. p. series lamps in replacing the old bright way system in the outlying business district.

To replace gas lights on streets, boulevards and parks, 1,080 600 c. p. lamps on standards will be used. Twelve of the city's parks will be lighted with 357 units of the same type.

The total number of new street lights covered by the contract is 6,980. These replace 5,421 street lights which were in use April 1, 1921.

CONCRETE TEST HIGHWAY AT PITTSBURG, CALIFORNIA

The need of more information on some phases of highway construction is recognized by engineers and the general public in California as elsewhere. With this in mind, and in the belief that the material they manufacture would prove a valuable aid in securing reliable results under some of the most difficult conditions, the Columbia Steel Company of San Francisco inaugurated the construction of a test highway. In the execution of this work to date they have received the hearty cooperation and assistance of other interests desiring to contribute in this manner toward acquiring more knowledge on the subject of highway building.

The test highway has been built at Pittsburg, Calif., in accordance with the plans published in a preliminary report, dated July, 1921, issued by the Columbia Steel Co. This highway will be tested to destruction by means of motor-truck traffic. The highway was completed on July 11 and the traffic on it has started.

This traffic will be continued until the several types of road are broken. The road is built entirely on adobe, and it is so arranged that water can be turned into the side-ditches and its surface brought to an elevation equal to that of the top of the sub-grade.

There are also four tunnels constructed for the purpose of making a study of the action of the slabs and sub-grade under traffic and variable moisture conditions. Careful observations will be made from time to time to determine the rate and amount of saturation of the sub-grade from the water-filled ditches. Other observations which this limited space prevents describing will be made.

The 13 types selected for investigation are the results of conferences with and suggestions by leading federal, state and county highway engineers, and represent their ideas as nearly as possible within the scope of this test.

As the investigation proceeds the information secured will be given free to the public by means of bulletins, so far as the compilation of results permit. This is a public test for public information, and the interest of those who have the construction of "good roads" at heart is solicited. All are invited to visit this test highway at any and all times they may desire, and these visits will be very welcome to those in charge of the investigation.

Mr. Lloyd Aldrich, consulting highway engineer of San Francisco, is engineer in charge and John B. Leonard, consulting structural engineer of San Francisco, is associate engineer.

FREIGHT RATES ORDERED REDUCED ON ROAD MATERIALS IN OHIO

The State Utilities Commission of Ohio, backed by public sentiment, expressed through the newspapers, by official sentiment through state officers up to the Governor, and the testimony given before it by representative paving brick manufacturers, have ordered substantial reductions in intrastate paving brick freight rates, effective Oct. 20, 1921. Sand and gravel shared also in the ordered reduction, but not to the extent of the consideration given paving brick rates.

The ordered reduction restores rates on the foregoing materials to those in effect prior to August 25, 1920; in other words, removes the last 40 per cent increase. Then, in addition, because, as stated in the order, paving brick had received prior advances disproportionate to those given other competing materials, an additional reduction of 10 cts. a ton is ordered on paving brick alone. For example, a present freight rate in Ohio of $2.24 becomes under the order $1.50 per ton; a $1.84 rate becomes $1.22, to use two common Ohio rates as illustrations.

Here is a precedent for other states.

WATER WORKS SECTION

WATER RATES FOR INDUSTRIAL CONSUMERS

By E. E. Bankson, of the J. N. Chester Engineers, Union Bank Bldg., Pittsburg, Pa.

A common source of controversy, in water rate cases, is the industrial rate or rate to large consumers, and on inspection of representative rate schedules which have been approved by courts and commissions there is to be found a wide variation in the attitude towards this industrial rate. The purpose of this discussion is to examine the permissible variation, in this respect, within a consistent course.

The generally accepted basis of any rate theory is that "the individual charge for service shall be equal to the cost of the individual service," although there are many cases where the decision, as to rates, has been influenced by the value of the worth of the service as indicated by competition or possible loss of business and an effort will first be made to explain or partially define the useful scope and limitations of these two factors.

The Cost Basis

The cost basis (including depreciation and fair return) may be considered as the ideal condition serving as a guide in fixing the rates, the magnetic pole, so to speak, toward which the rates will be drawn, and they may or may not closely approach the ideal point depending on the relative strength of opposing forces in the form of competition, etc. The embryo advocate of the "cost basis" is usually unable to recognize the justice of the "value basis" under any circumstances, apparently failing to appreciate the fact that, though we are at liberty to fix rates according to any measuring stick which seems good, we have no way of compelling the consumers to purchase at the stated price.

As a general proposition the primary function of a water works plant is that of supplying water to the community both for general purpose and for fire protection, with the industrial supply as incidental to the main issue, although the reverse may be true in extreme cases. Certainly the grid-iron distribution system, which is a large percentage of the total investment, as well as the fire reserve, and filter plant, if any, is created for the community.

The decision, therefore, as to the industrial supply resolves itself into the question as to whether or not this incidental supply can be sold at a profit, and Mr. Chester has very clearly defined a profitable or permissible rate for large consumers as "any rate which produces a result that will add to the net revenue of the plant," but coupled with this definition is also the understanding that such a rate to a large consumer should be the highest rate at which the sale can be effected; a higher rate would defeat the sale. This rate, too, will vary with different localities, for instance the Pennsylvania Railroad takes its entire supply in that district from the Dennison Water Co. at approximately 10c per 1,000 gals., while an average rate of 7½c does not prove attractive to that same company in the Upper Sandusky district.

The foregoing discussion does not imply that an attractive rate should be offered to all possible takers, for there would be no justice or equity in providing this incidental supply at a loss; in fact, the only justice in fixing a rate to a large consumer which would appear lower than the rate indicated by the "cost basis" lies in the fact that the net revenue thereby obtained is to be applied in fixing a lower rate for the major supply than would be possible without the revenue from this large consumer; granting a fair return on plant investment in either case. For instance, if a manufacturing plant can easily obtain and only requires raw water under a low head, and if the city is supplied with filtered water under a high head, the lowest rate should be made unattractive to the manufacturer, for in their case the value of the service to the manufacturing plant is lower than the minimum profitable rate to the water department or company, and to supply this incidental service at an attractive rate would actually increase the burden to the domestic consumers.

Another most vital point in this connection is that the attractive price to this large consumer may prove profitable only

because of the "existence" of a surplus plant capacity which can be used in delivering this incidental supply, and that this price might prove unprofitable as soon as additional capacity was made necessary. In a recent case we protected the Water Company's position in this respect by indicating the low rate as applying only "so long as the present facilities of the Water Company are adequate," and in another case where the plant capacity had been reached, and where one industrial plant was taking over half the delivery at a low rate, we doubled the rate to large users so that the rate would be in excess of the value and this large industry be thereby eliminated (or retained only at a rate which would justify an increase in plant capacity).

Example of an Actual Case

An example of an actual case may be cited where an analysis of conditions will serve to support the foregoing statements:

A large industry in the town of "X" is now providing its own raw water supply at a cost, for 1920, of 1.6c per 1,000 gals., and is in a position to supply the necessary filtered water for its own plant at a computed cost of 4.2c per 1,000 gals. Allowing for contingencies, however, and for the advantages of the more reliable and carefully guarded city supply, they paid, in 1920, an average rate of 5¾c to the city plant for their drinking and sanitary requirements.

The rate of 5¾c is admittedly less than the rate which would be indicated as equitable under the "cost basis" by an impartial analysis of the annual burden from the Water Company costs, but it is the highest rate at which the business of this industry can be retained, and because of retaining this business at this rate the fair charge to other consumers is maintained at 12c per 1.000 gals., less than it would be if this industrial business were lost to the Water Company.

On the other hand even the out-of-pocket cost of the Water Company service is 2.1c per 1,000 gals., which would be increased by necessary fixed charges on additional plant capacity if the Water Company should attempt to supply its filtered water to the industrial plant as a substitute for the present raw water private supply. For the Water Company to offer a rate which would attract the entire demand of this industry in competition with its cost of 1.6c would result in an increased burden for domestic consumers, provided a fair return is maintained for the water. The equitable conclusion is evident that the lowest rate offered by the Water Company should be made attractive to the sanitary demands of the industry, but *positively unattractive* to the raw water demands in this particular case.

The foregoing principles applied to the majority of water rates would indicate that the value of the commodity is more compelling than the computed cost of individual service, and it is to be noted that, under a total fair return, if the industrial rate is fixed lower than cost, the domestic rate must be fixed higher than cost, which is still within the value of the product, provided the domestic consumers continue their connections. Commissions have often recognized this feature of value through their approval of rate schedules so designed, and different phases of value have been recognized in many decisions, a few of which we quote at random:

Different Phases of Value Recognized

In the Bar Harbor Power Company's Case, Maine, "Rates should not be higher than the value of the service to the consumer."

In the Greenville Water Co.'s Case, Maine, "If, in a given instance, it becomes a question whether the company shall receive an adequate return or the rates shall be just and reasonable to the customer, the company must yield to the superior rights of its customers."

In the Butte Electric Co.'s Case, Montana, "For whatever force is given to the principle that a just rate must take account of the value of the service to the public, it cannot be said that the latter principle destroys the fair return principle, i. e., while the service may be worth nothing to the man who cannot pay, the utility cannot be compelled to meet his necessities."

In the Illinois Northern Utilities Co.'s Case, "Gas plants, located in small communities, cannot expect rates sufficient to make them paying concerns because such rates would exceed the value of service to the consumer." Which the writer interprets to have the same meaning as expressed in the following case.

In the Lehigh Valley Transit Co.'s Case, Penna., "There are limits of fare beyond which transportation companies cannot go without driving away their business."

The foregoing analysis indicates that "value" is the final controlling element in many cases and that an industrial rate determined by value rather than by cost may be within good legal practice, as well as good business, so long as the existence

of that rate will effect a lower rate to other consumers. The "cost" basis is the goal towards which we strive, and which can be attained in some cases.

The Case of Pittsburgh, Pa.

There are instances, such as we found in the case of the City of Pittsburgh, where the most compelling influences guiding the broad and general policies of the water service are in support of, rather than against, the "cost basis" for fixing rates. For the large steel mills and furnaces, located on the river banks and requiring only raw water under a low pressure, it was clearly seen to be poor economy for them to share with the city the cost of purification, pumping over the hilltops, and finally transporting the water long distances, when a satisfactory supply is at their doors at a very much lower cost. It would in the end create a financial loss for the City of Pittsburgh to deliver water for such purposes at a price which would prove attractive to the manufacturer so located; especially so in this case, where we discover one company pumping more water than that handled by the city plant, and years ago the City Council very wisely fixed the lowest rate at a point which is unattractive to the steel mills and insures the city against an uneconomical increase in plant capacity of monstrous proportions.

Every Case Stands on Own Merits

From the foregoing discussion the reader might possibly erroneously infer that we are advocating the "value" basis as a general rule for fixing water rates to industrial consumers, but such an attitude is exactly contrary to our thoughts. We are rather pointing out that every case stands on its own merits, and we do advocate a sane, logical and consistent analysis resulting in the correct policy for each case.

The question of water rates to industrial consumers is nothing more than the question of the amount or extent of the "Slide" in the meter rate schedule and, on the basis of cost alone, you may find conditions supporting rates all the way from an absolute flat rate to all consumers on the one hand increasing to a very decided slide on the other hand.

Practice of the General Water Co.

The General Water Company, a Pennsylvania corporation, operates a water works plant which is owned and used jointly by some half dozen coal and coke companies. The Water Company delivers water to a central point and provides supply lines for a certain distance in any direction at which point a large consumer may join on and complete the line to his plant desiring service. In this case, therefore, remembering that all of the consumers are large industrial, there is no call for any slide in the schedule and no urgent need of any variation due to service charge or minimum charge.

Conditions at Milwaukee

The conditions at Milwaukee, Wis., indicate a basis for rates of only a slight practical difference from the foregoing. In this case the consumer, big or little, pays outright for his gridiron street main, individual service line and meter, thereby eliminating from the rate base the more common causes for slide in the schedule with the exception of the cost of meter reading, billing and collecting, which cost is covered in this case by a uniform service charge, and the remaining cost consists of the uniform or flat price per 1,000 gals. to one and all. If it were practical to cover the service charge in the price per 1,000 gals. there would be created a justification for a small slide in the rate schedule.

At Cleveland, Ohio

It is the understanding of the writer that Cleveland follows practically the same policy as Milwaukee, except that the Cleveland water department furnishes the meter, creating a fair additional cost, which, if thrown entirely into the rate per 1,000 gals., would justify still more slide in the schedule than as mentioned for Milwaukee.

At Erie, Pa.

A practice similar to that followed by the City of Pittsburgh is next in line which differs from Cleveland, with respect to items mentioned, only in that the water department furnishes also the gridiron street main, indicating still more slide in such a schedule, while the practice in the City of Erie, where the Water Department provides all of these things and the individual service line in addition, justifies the greatest slide in the schedule of the entire list so far.

Following the case of Erie, let us look at a private plant, where the Public Service Commission requires, of the Water Company, all of the items of consumer service rendered by the Erie plant, and where we are also confronted with the condition that the industrial rate be fixed on the basis of "value" at a lower rate than pure costs would indicate. We then are justified in a still greater slide in our schedule, or, more properly, a part of this slide in all cases should be covered by a service charge, or a minimum charge.

The maximum slide in a rate schedule

is justified in the case of a private plant operating under the conditions of the case last mentioned, with the addition that there exists an excess in plant capacity which would otherwise remain idle, and where it is permissible temporarily to utilize this surplus capacity at a low rate sufficiently in excess of the cost of fuel and coagulants.

The control in these various cases might be considered as appearing on a curve or diagram, representing slide in schedule, with the General Water Company appearing at the bottom of the curve, while at the top would be found the small private water companies giving, under Commission jurisdiction, all of the mentioned items of consumer service and under the controlling influence of the "value" basis, supported by an otherwise surplus plant capacity. To find the relative position, on this curve, of any plant or water company it is only necessary to examine its characteristics and environment, but in any and all cases the final decision as to rates and slide in schedule should and must be based on sound, logical and controlling reasons.

This paper was presented by Mr. Bankson before the 1921 annual convention of the Central States Section of the American Water Works Association.

SOFTENING WATER FOR BOILER USE BY ZEOLITE METHOD

To the Editor:

Milton F. Stein, C. E., in his article, "The Economy of Feed Water Heating and Purifying in the Water Works Pumping Station," in MUNICIPAL AND COUNTY ENGINEERING, Vol. LX, No. 5, May, 1921, does not appear to recognize the utility of the art of softening water for boiler use by the Zeolite method.

Zeolite water softeners have been on the market in this country for more than eight years, and records touching on their application indicate that the vast majority are used for the production of boiler feed water, both in condensing and non-condensing plants.

The Zeolite water softener should not be compared with "the usual type" of mechanical filter, since its functioning demands a special construction and accessories that make it a unique apparatus. The problem of filtration is to pass water through a layer of material which has openings in it sufficiently large to permit the free passage of the water and small enough to stop the suspended particles that are desired to be removed. The Zeolite water softener problem is one of bringing all particles of the water into contact with the Zeolite material, which at once introduces a vastly different mechanical problem from that of simple filtration. It should further be noted that no Zeolite mineral is on the market in its natural form, for all minerals that originally possess some exchange properties must be artificially prepared or treated before they become valuable for softening water.

Mr. Stein's description of the softening of water is correct, but his comparison with the quality of softened water produced by the lime-soda process is by inference incorrect, for one infers that the lime-soda process invariably removes objectionable salts from the water, and invariably reduces the total dissolved solids to a very low amount, while the Zeolite process "exchanges objectionable salts for others," which action is condemned by inference as a defect of the Zeolite process.

The facts are that the lime-soda process partly precipitates from the water a portion of the temporary hardness, generally known as carbonate hardness, but the lime-soda process cannot precipitate all of it, because the resultant calcium carbonate is soluble in water to the extent of about two grains per gallon. Furthermore, additional carbonates generally exist in the colloidal state, which do not precipitate, and which pass over to the boilers in the treated water.

The lime-soda process cannot precipitate out any chloride or sulphate hardness, generally referred to as permanent hardness, and when operating at highest efficiency only transforms such hardness to equivalent sodium salts. If, therefore, Zeolite softened water is to be condemned by reason of its sodium content, the conclusion follows that lime-soda softened water must likewise be condemned, as it contains the same element.

It is obvious that the greatest possible theoretical reduction of total solids by the lime-soda process is less than the total amount of temporary hardness contained in the water to be treated. Furthermore, an excess of reagents must be used to maintain the chemical reactions, and this excess, existing as soluble salts in the treated water, increases the total solids above the amounts that would theoretically be expected. It is significant that in the actual operation of lime-soda softeners this excess is considerable.

The two items of sludge disposal and after reactions are not mentioned, although operators of lime-soda softeners are keenly aware of the difficulty and expense caused by the cleaning and disposition of sludge.

It is stated that "sodium salts are known to aggravate foaming," and that "it follows that if a very hard water is softened by the Zeolite process it will indeed be softened, but in its changed condition may cause trouble through priming and foaming." Since permanent hardness (chloride and sulphate hardness) is not precipitated out by the lime-soda process but is transformed into sodium salts, it follows that waters containing a measure of permanent hardness when softened by the lime-soda process will also be high in sodium salts, and there would therefore be no difference in the priming and foaming qualities of such a water were it to be softened by the Zeolite method.

Sodium carbonate is not only contained in lime-soda treated water but is an important constituent of many boiler compounds. In fact the addition of sodium compounds to boiler feed water is an established practice to correct objectionable feed waters, which practice has not given bad results. On the contrary, it is considered highly beneficial to the boiler and has always fulfilled its purpose when cor rectly used.

Foaming is not a boiler trouble to be feared in well conducted boiler operation, where the boiler saline concentration is regulated by a blow-off schedule that keeps the concentration of boiler salines below the foaming limit. As a matter of fact where boiler feed waters are reasonably free from mud and other suspended matter foaming should be mostly considered as an announcement by the boiler that something is wrong, an automatic alarm in reality, rather than a boiler trouble.

Again, it is contended "that waters high in sodium salts have an embrittling action on steel." It should be carefully noted that this statement has never been proved, but on the contrary has frequently been denied by many prominent engineers and scientists.

Occluded hydrogen is generally considered a measure for the determining of the embrittlement of steel. Fuller* among others proved that the amount of hydrogen occluded by steel in contact with hot tap water or steam is the same, or higher, than the amount occluded when a highly concentrated caustic solution was used, and it may therefore be seen that the contention, "that waters high in sodium salts have an embrittling action on steel" has no sound basis in fact. In general it may be said that embrittlement of boiler materials and the occurrence of cracks is confined to those parts in which internal stress has been introduced during fabrication. The most common kinds of such cracks are the lap-joint cracks. The Hartford Steam Boiler Inspection and Insurance Company† has maintained for many years that the mechanical stresses set up by boiler construction are primarily responsible for the cracking of boiler sheets in or near the seams.

Further consideration demonstrates that the actual amount of sodium salt in the boiler makeup water is of no importance whatever in the above discussion, for be it great or small the evaporation of water in the boiler will bring these salts to a point of concentration where blow-off is required, and from that time on the boiler will always contain this amount of sodium salts.

The use of Zeolite softeners as applied to boiler feed water is not limited to any particular set of conditions, but in fact applies to all ranges of water supplies and operating requirements. Where waters are high in permanent hardness the Zeolite method alone is a satisfactory solution, and in the case of high temporary hardness the problem is advantageously solved by the combination of lime with Zeolite softeners. The lime is used to precipitate out the major portion of the temporary hardness, while the latter finishes off the work of the former and completely removes the permanent hardness, thus delivering a clear neutral water of zero (no) hardness.

Since Zeolite softened water fed to boiler room apparatus is completely free from scale, sludge or mud-forming impurities, which cause great waste of fuel and overheating of metal, and since the absence of scale eliminates internal cleaning of boiler surfaces, it may be seen that singularly attractive advantages are presented by the Zeolite water softener.

Very truly yours,

THE PERMUTIT CO.,

440 Fourth Ave., New York, N .Y.

Sept. 30, 1921.

*Trans. Amer. Elec. Chem. Soc., Vol. XXXVI.

†The Locomotive, Apr. 1905, Repub. The Locomotive, Jan. 1921.

CONTROL OF THE OPERATION OF RAPID SAND FILTER PLANTS

By J. W. Ellms, of The Frazier-Ellms-Sheal Co., Consulting Engineers, Illuminating Bldg., Cleveland, Ohio.

It is now over 30 years since the Massachusetts State Board of Health began its investigation of the water supplies of Massachusetts. At that time the study of the physical and chemical characteristics of natural waters was regarded as of prime importance, comparatively little attention being paid to their bacteriological content. The microscopical examination of waters for algae, diatoms, protozoa and similar organisms had also been shown to throw considerable light on the quality of surface waters for public supplies. As bacteriological technique was perfected, and as the relation between polluted water and certain diseases became more evident, the examination of waters for the number of bacteria which they contained, together with attempts to isolate certain species of bacteria, came more into vogue.

The early experimental work on the merits of rapid sand filters for purifying public water supplies, carried on at Providence, Louisville, Cincinnati, Pittsburgh, New Orleans and Washington required the utilization of all the available methods of examination, and as a result of this work analytical methods were much improved, and their interpretative value much better understood. The various kinds of natural waters experimented with in these investigations impressed upon the workers the need for careful standardization of the methods of analysis. This idea took concrete form in the appointment of a committee on this subject by the American Public Health Association. The original work has been revised from time to time, and is at present in process of further revision in order to keep pace with our advance in knowledge on these subjects. In order that this revision of methods may be adequate, the membership of the committee should be enlarged to include representatives of several of the other national scientific associations, such as the American and New England Water Works Association, the American Chemical Society, the American Society of Bacteriologists and the American Societp of Microscopists. A revision of these methods by such a committee would be authoritative in the broadest sense, and would establish a firm basis for comparison of results and for interpretation of those results.

Laboratory Control

The control of the operation of rapid sand filter plants is based largely upon accurate information obtained in the laboratory. If this information is immediately available, so that processes may be modified during the progress of the water through the plant, or if it can only be obtained many hours after the water has been treated, the data secured should be utilized directly or indirectly by the operator in order to guide him in handling the plant. This is much easier said than done, even if we grant the accuracy of the laboratory methods. Facts are of small value unless they are properly interpreted, and unfortunately there is not the consensus of opinion in regard to interpretation even amongst those presumedly qualified to express an opinion.

Points of Disagreement

To illustrate conditions commonly met with, we do not agree always upon the merits of fine versus coarse flocculation after treatment with chemicals, upon the proper periods of sedimentation, upon the velocities that may safely be used in conduits, upon the means for preventing incrustation upon filter sands when lime is used, upon the completeness of the precipitation of aluminum hydroxide where alum is employed, upon the size of the sand grains that will produce the greatest bacterial removals, upon the extent to which chlorination of filter effluents may be carried to offset lowered filter efficiency, upon the signficance of secondary bacterial growths in settling basins and perhaps filters, upon the weight to be attached to the presence of B. coli, and to numerous other questions constantly arising from the data that the laboratory produces, and from observation of plant conditions. That waters differ widely in character and consequently in their susceptibility to purification processes is axiomatic. Nevertheless, the most experienced operators are inclined to draw conclusions from too little data and from too limited knowledge of the varied waters which are being purified for public consumption.

Caution as to Innovations

It cannot be too strongly stated that many of the fundamentals of rapid sand filter plant control are the result of the accumulated experience of more than 25 years' labor in extensive experimental work, costing many thousands of dollars, as well as the practical operation of numerous plants purifying waters of widely varying character. The utilization of new

principles which are the result of scientific research, but which have not been tried out on a practical scale, requires caution and an open mind. What may be true under controlled conditions when demonstrated in a laboratory beaker, may be far from true under the conditions existing in a large filter plant. Unforeseen conditions, and factors that cannot be controlled may so modify the original principle that its value for practical purposes is nil.

In spite of the advances made in the art of water purification during the past quarter of a century no true scientist would claim that the art has been perfected or further progress impossible. The careful scrutiny of all new ideas advanced and their subjection to rigid-practical tests are not only scientific but wise. The revolutionizing of an art requires the establishing of new principles, beyond any question of doubt, and not until this is done may past practices be thrown into the discard.

Water purification in its broadest sense may perhaps include the purification of drinking water, the softening of water for industrial purposes, the disposal of sewage, and the adequate treatment of industrial waste liquors of many kinds. The field for research work is enormous, and the problems involved intricate. There is plenty of room for many workers. If each contributes his mite to the problems presented to him he will have done his part.

Conclusions

The points I wish to bring out in this paper may be summarized as follows:

1. We must have a set of standard methods of analysis which will be authoritative and adequate for the problems to be solved.

2. We must formulate our problems in such a manner that it is evident to all what the questions at issue are.

3. We must be receptive to new ideas, examining them with candor, neither accepting nor rejecting them without rigid testing.

4. Finally, we should hold fast to that which has been established by costly experiments and practical operating conditions until new methods have demonstrated beyond doubt that something better is possible.

This paper by Mr. Ellms was presented at the 1921 annual convention of the Central States Section of the American Water Works Association, at Columbus, Ohio.

HUMAN RELATIONS OF PUBLIC UTILITIES

By H. C. Peffer, Head, School of Chemical Engineering, Purdue University, Lafayette, Ind.

(Editor's Note: In introducing the following remarks before the Indiana Municipal League Professor Peffer said: "A college professor is no more fitted by virtue of his position to speak with authority on all subjects than any other man. His opinion, along his special line, is entitled to due respect; outside his specialty, his opinion may be only an impertinence." Unfortunately, in the opinion of many who have not outgrown their schoolboy prejudices, even the existence of a professor is an impertinence. Perhaps that is why the editor gave up teaching in the class-room to take up teaching through a professional journal. However that may be, and the point is of no consequence, better men are remaining on the job in our schools and colleges. Prof. Peffer, who, by the way, did a splendid piece of public service work as representative of the Indiana Municipal League on the Indiana Gas Standards Committee, has here expressed some very true and wholesome views.)

As a result of a number of years of contact with the human family in the various relations of subordinate, employer and teacher, one thing stands out, viz., faith in humanity; most men are essentially honest.

What I meant to say is that most people intend to be honest, believe themselves to be honest, and aim to deal fairly with others; in fact, most of them are honest enough within the limitations of human nature to deal according to facts in an impersonal proposition.

It is, however, a feature of human nature to be suspicious of strangers or those outside of one's immediate circle, and to trust one's friends; probably an inheritance from savage ancestors.

We have here the nub of the utility situation, coupled with the fact that we have during the past 50 years advanced more rapidly in applied science and engineering than in the science of human relations.

Certain of the relations of the utilities to the public are based on facts; others depend on opinion, very often based on prejudice or irritation, without any basis of facts.

It is believed to be a fair statement to assert that the utilities serving the public are in general as efficiently handled from an operating standard as business enterprises in general. They are among the

largest employers of high grade technical specialists and among first to utilize modern inventions and improvements.

In their contact with the public, however, they are probably less efficient than other business organizations, to the cost of both the utility and the public.

That the conditions under consideration are not unavoidable and not a part of the industry may be evidenced by instances in other lines. The department stores of John Wanamaker, Marshall Field and others, probably have as many contacts with the public as most of the utilities. Anyone who has travelled in Canada has probably been impressed with the courteous, helpful attitude of railway and street car employees and of the police.

Manufacturing concerns whose contact with the public are small in comparison with the above allow only experienced, high grade men to come into contact with the public and find that it pays.

The Indiana Gas Standards have attracted much attention outside the state because of the method of their formulation and because they embody the results of a comprehensive survey of the gas industry in this state, by competent engineers, and under actual operating conditions.

It will be recalled that the investigating committee appointed by the Public Service Commission comprised representatives of the Public Service Commission (the State), the Indiana Gas Association (the Manufacturers), the Municipal League of Indiana (the Public), and the National Bureau of Standards (an impartial scientific body).

It would scarcely be expected that in a committee representing such apparently diverse and conflicting interests absolute harmony would prevail. As a matter of fact, differences of opinion did arise, and were warmly contested; in the end, however, all disputed points were settled as they should have been, on the basis of the scientific and technical facts elicited during the investigation.

The recommendations of the committee, subsequently promulgated by the Public Service Commission, are believed to render substantial justice to all concerned. Under the regulations, as they now stand, the gas companies are able to operate without hardship, and under definite conditions which they assisted in formulating. The consuming public is assured of gas of uniform quality, of probably higher calorific value than under the old standard.

The foregoing is cited as an example of efficiency where it is most needed, in the relations and dealings between the utilities and the public which they serve.

It is necessary to remember, however, that the public, like the individual, has little regard for facts when exasperated by some real or fancied grievance; on the other hand, it will tolerate much from those who have its friendship.

The railroads are today suffering the vengeance of exasperated public opinion. It is extremely doubtful whether the public would have ever become sufficiently interested as to the amount of water in stock issues and like matters to take any action, if they had not been the victims of discourteous or even outrageous treatment from employees of the railroads. The American public believes in a square deal.

All this is not for the purpose of introducing a new patent medicine which will cure all our ills; we have had too many economic and legislative patent medicines in the past.

What the utilities now need most is a course in the science of human relationships and a liberal supply of the Abe Lincoln brand of human nature. With mutual trust and confidence reestablished, the utility problem will solve itself.

THE "IDEAL" ELEVATED WATER TANK

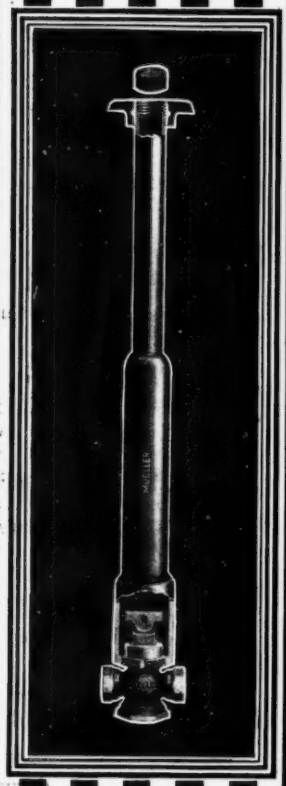
To the Editor:

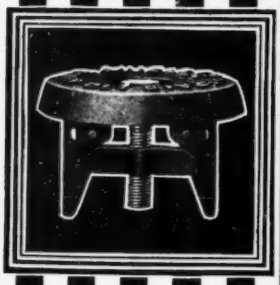
One point which Mr. W. L. Simpson did not bring out in his article in the September issue regarding an elevated concrete water tank in Yorktown, Texas, is worthy of mention.

Mr. Simpson says in effect that this tank reduced the insurance key rate for the town on account of the increased pressure produced by the tank. He also says that the water works system which he describes seems to be an ideal arrangement for a small city.

This is well and good, but it should be brought out that the insurance rates were not reduced because the tank was built of concrete and that the rates would have been equally reduced had the city constructed the long-standard elevated steel tank.

Mr. Simpson does not make clear whether the water supply system which he describes is "ideal" or whether the tank itself is "ideal," and to make sure that no one assumes the latter to be the case it should be mentioned that if any elevated tank is entitled to be termed





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"ideal" the steel tank is certainly entitled to this distinction.

The elevated steel tank has been the standard in American municipalities for more than 25 years and it has universally rendered a most excellent service—combining such qualities as low cost, long life, freedom from cracking, leaking, rotting and burning, and solidarity on account of its unit construction and self-supporting bottom—which will probably never be equalled by any other type of tank.

I think this explanation is due, at least as a small token of appreciation to Mr. Horace E. Horton who invented the elevated steel tank with a self-supporting bottom, and as a means of informing city officials and others of the fact that concrete as yet has not proved its place as an "ideal" material for the construction of elevated water tanks.

Very truly yours,

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Sept. 28, 1921. Chicago, Ill.

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The new power backfiller designed by the Pawling & Harnischfeger Co., of Milwaukee, to speed up the work of backfilling trenches and ditches, is designated as P. & H. 203. This machine is mounted on full corduroy tread and is operated entirely by one man, who guides the progress of the machine as well as the scraper bucket and boom. The boom on the 203 is 30 ft. maximum, 20 ft. minimum, and the engine is heavy duty 18 h.p. four-cylinder gasoline unit. The illustration accompanying this description shows the machine at work on a city of Minneapolis job, filling in a water pipe trench.

With the boom extended to its maximum length of 30 ft., four loads may be filled in per minute. With shorter boom length more loads are dumped into the trench per minute. In fact, just the one man, the operator, with this P. & H. backfiller can work steadily without fatigue and do the same work as a crew of 40 to 50 laborers backfilling with shovels. The construction is like P. & H. Excavator-Cranes; the body being made of heavy I-beam, gears cut from solid block, steel plate corduroy treads, gear-driven, and centralized control.

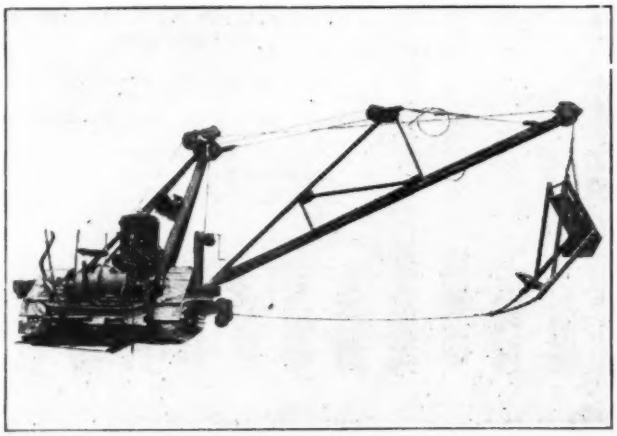
WHAT DECATUR, ILL., IS DOING TO RELIEVE UNEMPLOYMENT

To the Editor:

I have just read your editorial appeal in your September issue, for more municipal work to relieve unemployment.

As I read it I wondered if you were acquainted with what Decatur, Illinois is doing and has been doing for the last 12 months. We think there is not another city in the country that is doing what we are to help the town and that means also to help idle labor. Decatur is a city of 43,818, 1920 census, and here is some of the work that is in progress:

Concrete and earth dam	$800,000
Building of new bridge	230,000
Raising approaches and piers of several other bridges, about	200,000
Clearing land in the impounding reservoir	90,000
Abandonment of one bridge and the construction of a road in place of it—at least	20,000
Rip rapping blocks	20,000
Sewers and water mains in new additions	75,000



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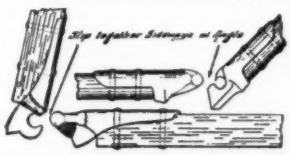

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Five miles of concrete sidewalks planned, for one new addition, that will go down as soon as sewers and water mains are in.

Then this little town of ours had to buy about 3,800 acres of bottom land, much of it very good farming land, for the impounding reservoir.

The money for a part of the impounding project was provided by a patriotic citizenship. The city needed a million dollars. State laws restricted its bonding power and its taxing power. A voluntary corporation of citizens was formed under the name of the Decatur Water Supply Co. and issued stock paying seven per cent. In a few days this issue was oversubscribed by our people.

I believe that the work Decatur is doing ought to be a good example for other Decaturs and other cities of the country. Do you know of another town that is doing as much as we are?

Very truly yours,
HENRY H. BOLZ, Reporter,
Decatur Herald.

Decatur, Ill., Sept. 28, 1921.

(Editor's Note: Our correspondent is justly proud of what his city is doing. We have always had a good opinion of Decatur and are glad to have our judgment so conclusively confirmed. This is, indeed, a splendid example for other cities. Here is a city living up to the best traditions of an honored name.)

TYPHOID FEVER AND PREJUDICE AGAINST CHLORINATION OF DRINKING WATER

How a community, by too strenuous protest against an unpleasant but transitory condition, can condemn itself for years to an annual recurrence of disease, is strongly brought out in a report by Dr. R. G. Perkins, of the Cleveland Division of Health, recently reprinted by the U. S. Public Health Service.

Cleveland, says the report, obtains its water through two cribs placed 4½ miles out in Lake Erie and delivers it through two pumping stations, at one of which it is filtered and at both of which it is chlorinated.

Chlorination was begun in 1911, when the growth of the city and the increasing pollution of the lake water made treatment essential. After numerous experiments the "dosage" of chlorine necessary to make the water safe was determined. This amount was added and the typhoid curve fell with unusual sharpness. Unfortunately, conditions compelled the delivery of the chlorinated water through the mains in some parts of the city so shortly after it was treated that the taste of chlorine was still apparent.

Much complaint followed, but was dying out when, early in 1912, a flood in the Cuyahoga River, which enters the lake at Cleveland, carried sewage and trade wastes out into the cribs, through which they reached the city mains. The trade wastes gave to the water an unpleasant taste, which everybody promptly blamed on the chlorination.

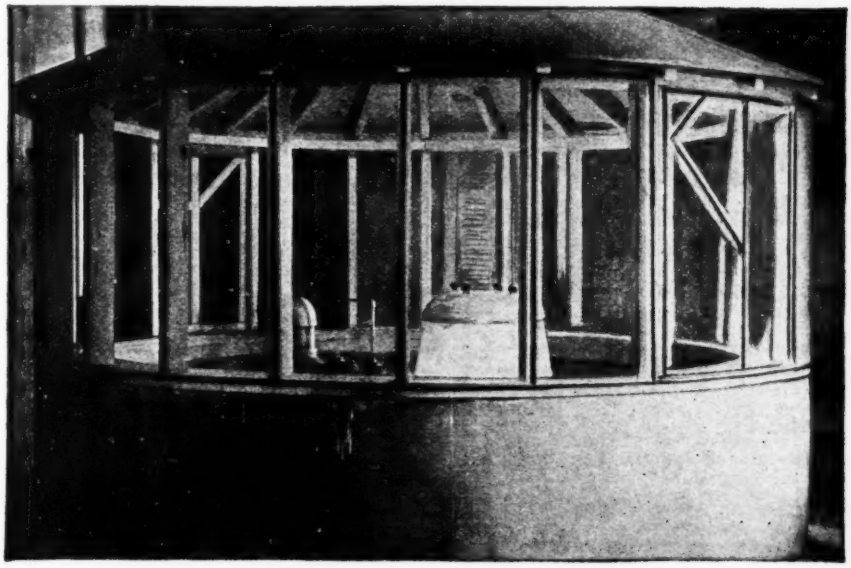
The mayor bent beneath the storm of protest. By his order the "dosage" of chlorine was reduced and during the ensuing nine years it has never been high enough, the report says, fully to counteract the ever-present pollution in the raw water.

The typhoid bacillus in drinking water is very difficult to find by laboratory methods, but the finding of sewage pollution is always considered as a warning of its possible presence.

In 1918, in the effort to better conditions, a filtration plant was put into service at the larger pumping station, which handles nearly three-fourths of the city consumption. Laboratory tests, however, show that sewage pollution is present in the unfiltered water in the city mains nearly half the time and in the filtered water from 8 to 22 per cent of the time.

In 1918 and in 1920, when these tests showed the water to be badly polluted, the number of cases of typhoid fever in the city that could not be traced to any cause other than the water was double those that occurred in 1919, when the tests showed the water to be much better. From this the report argues that the pollution of the water and the amount of typhoid fever are directly related; and that when the pollution is reduced to a minimum, as the report says that it can be by existing facilities, typhoid fever in the city will be very greatly reduced.

It should be added that the engineer of the water division of the city, a man whose experience the report concedes to be large, finds himself unable to admit that the untraced part of the rise of typhoid in Cleveland in the summer is due to water pollution.



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Construction News and Equipment

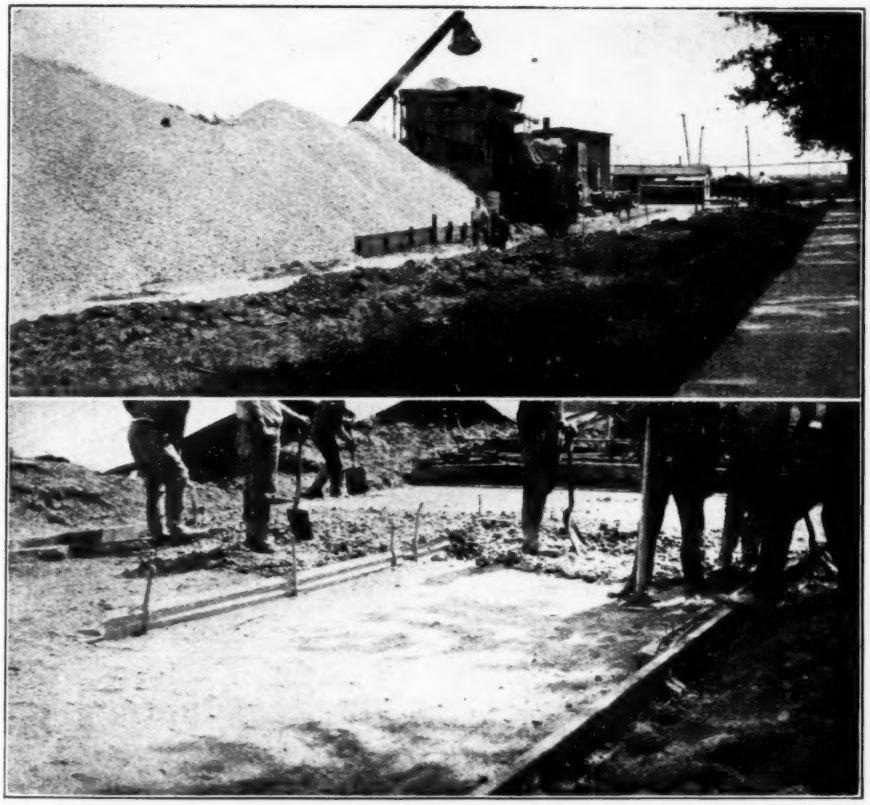
DAY LABOR CONSTRUCTION ON LINCOLN HIGHWAY AT FRANKFORT, ILL.

By B. H. Piepmeier, Engineer of Construction, Illinois Division of Highways, State House, Springfield, Ill.

On account of the high prices prevailing in the spring of 1921, very few highway contracts were awarded in Illinois. The State was very desirous of knowing the exact cost of construction under various conditions and therefore decided to build by day labor two sections of road, one at Frankfort, Illinois, and the other at Dwight, Illinois. The Frankfort section was selected, as it was the only earth gap in the Lincoln Highway between Joliet and the Indiana State line. The section is four miles in length and located through a rolling country. The Department therefore decided to utilize some of the war equipment, which it had received, in connection with the construction of this section of road.

Six Miles from One Set-Up

Six, 1½-ton G. M. C., pneumatic tired trucks with Lee dump bodies; 6 3-ton Velie trucks with Lee dump bodies, and 6 3-ton Velie trucks with standard hydraulic dump bodies, together with a 10-ton Austin gas roller, 5-bag Milwaukee concrete mixer, 15-ton industrial crane of the locomotive type, Lakewood finishing ma-



VIEWS ON DAY LABOR CONSTRUCTION ON LINCOLN HIGHWAY AT FRANKFORT, ILL.

Material Yard at Frankfort—Lower View shows Position of Corrugated Central Joint Before Concrete is Placed. Pins are Removed After Concrete is Spread, Leaving Corrugated Metal in Place.

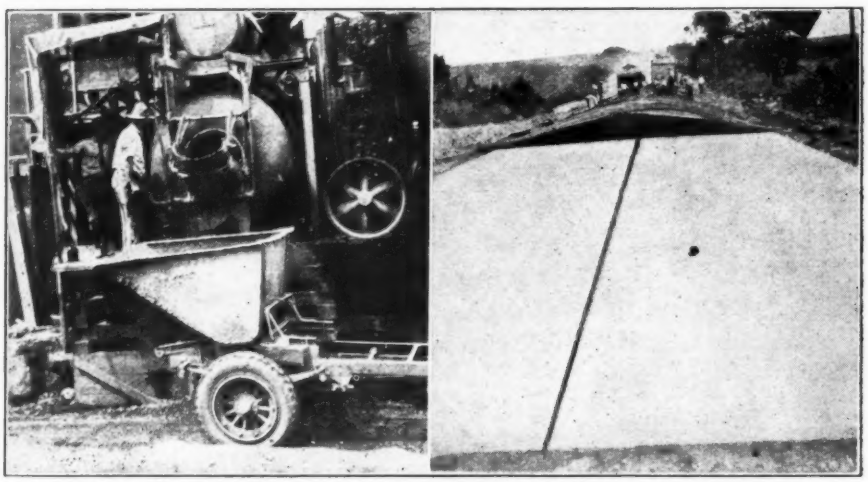
chine, and gasoline pumps were shipped to Frankfort and construction started June 8, 1921. On September 4th the entire four miles which it was originally planned to build were completed. The progress made and the results obtained were so satisfactory that an extension of two miles was authorized, making a total of six miles to be built from the one set-up.

Central Mixing Plant

On account of the conditions existing, it was decided that a central mixing plant at Frankfort would be the most desirable way of building the road. Bins having a capacity of about 25 cu. yds. for stone and 15 cu. yds. for sand were erected so that they could discharge material directly into the hopper of the stationary mixer. An 8-car cement shed was erected near the plant and so arranged that cement could be handled by wheel-barrows directly from the car or shed to the hopper on the mixer. The stationary mixer is so arranged that the batch may be discharged directly on the trucks. The capacity of the plant is approximately 700 ft. of 18-ft. pavement for a 10-hour day. The best day's run has been about 560 ft.

The New Illinois Standard Concrete Pavement

The type of pavement that is being built at this point is recognized as our new standard: namely, 18 ft. in width with a 2-in. crown having a uniform thickness of 7 ins. A 6½-in. strip of corrugated metal was placed lengthwise down the center line of the pavement. Five-eighths inch round deformed bars, 5 ft. long on 10-ft. centers were placed through the corrugated iron stip at right angles to it. Three-fourths inch plain round bars were placed 6 ins. from each edge of the slab. The ¾ in. round bars were first painted with a heavy coat of red lead paint to prevent rust. They were then dipped in hot asphalt having a penetration of about 35. The asphalt coating was for the purpose of breaking the bond so that in case of transverse cracks the longitudinal bar would not be ruptured but remain across the crack and act as a supporting dowel for carrying the concentrated load from one side of the crack to the other, thereby increasing the carrying capacity of the concrete slab. The corrugated metal strip in the center of the pavement was used to eliminate the unsightly longitudinal crack that frequently occurs in concrete pavements and to permit the dividing of the pavement in two parts so as to make the road safer for traffic. Corrugated metal was used, as it serves to make a dove-tail joint, thereby preventing a displacement of one side of the pavement above or below the other. The five-eights, 5-ft. long, deformed bars that were placed at 10-ft. intervals through the center joint is for the purpose of holding the two slabs together so that the corrugated joints will always be effective. Inasmuch as the corrugated metal joint comes within ½ in. of the surface of the finished pavement, a crack forms as soon as the concrete has taken its final set. This longitudinal crack is exactly in the center



VIEWS ON DAY LABOR CONSTRUCTION ON LINCOLN HIGHWAY AT FRANKFORT, ILL.

Five Bag Concrete Mixer at Central Mixing Plant—Right View Shows Center Joint Filled with Asphalt; Also Arched Covers to Protect Pavement from Wind and Sun.

KOEHRING

Washington Roads are KOEHRING Built

CONSISTENT performance, and not unusual and spectacular day-run records, expresses true mixer value.

In the state of Washington in 1920 four out of every five pavers used in road building were Koehrings. Study these figures:

Total yardage of concrete paving completed in state of Washington in 1920	2,706,738 square yards
Number of separate paving contracts in operation	73
NUMBER HANDLED WITH KOEHRING PAVERS	58
Number handled with all other machines	15

Authentic records show that Washington placed the greatest yardage per man in 1920 and at the lowest cost per square yard of any state in the Union.

And 58 of the 73 jobs making this record—79.45%—were Koehring equipped.

Let us emphasize it again—the Koehring Heavy Duty Paver is the paver of lowest cost per batch of concrete—the paver of absolute dependability.

KOEHRING COMPANY
MILWAUKEE, WIS.

of the pavement and when filled with a light tar or asphalt, covering a width of about 3 ins. immediately over the crack, serves as a dividing line for traffic going in opposite directions. It has been found that the dividing line adds very materially to the safety of the road, particularly after night. It has been found that the glare from the headlights of automobiles shows up the center dividing line and makes it possible for approaching vehicles to meet with a greater assurance of safety.

To date there have been approximately 40 miles of this new type of cross section of pavement built in Illinois. Thus far, it has been found so satisfactory that the Department will continue to build this type.

MARSHALL COUNTY, IOWA, CRUSHES STONE FOR PRIMARY ROADS

The primary road paving program laid out by the Marshall County, Iowa, Board of Supervisors, which threatened to be handicapped considerably by the lack of quickly available supplies of gravel for concrete aggregate, has opened up an entirely new industry for the county. In the extensive and various operations necessary in getting the rock out from under its heavy clay covering, crushed and delivered to the road builders, has furnished employment for many local men at a time when employment has been badly needed, says the Service Bulletin of the Iowa State Highway Commission.

After the voters of Marshall County had put themselves on record as favoring a hard-surfacing program for the Primary Road System the Board of Supervisors began to investigate the advisability of the installation of a rock crushing plant at Quarry, Ia., as a means of decreasing the cost of the pavement. After careful inspection and exhaustive tests five acres of land, part of what is known as Rock Valley Quarry, and which contains a fairly high grade of limestone deposit, were purchased at a price of $1,000 per acre. Approximately two acres additional were leased as a site for the crushing plant and railroad spurs. Quarry is located about four miles southeast of Marshalltown, at the junction of the Lincoln Highway and M. & St. L. railroad. The quarry had been operated about 20 years ago, furnishing dimension building stone. Work at that time had been carried on some distance below water level. Operations were discontinued at that time on account of the difficulty of getting rid of the water.

The land bought does not include the old workings, but extends back from the face of the ledge. It averages about 20 ft. above water level in the old excavation. Overlaying this ledge is some 15 or 20 ft. of clay, which necessitates extensive stripping.

Two methods of stripping of the clay presented themselves—first, by means of hydraulic pressure; second, by means of steam shovel. On account of several serious difficulties presented by the hydraulic method, and the fact that a cut of several thousand yards of excavation was necessary for the railroad spur entrance, the steam shovel method was adopted and a model "21" Marion Steam Shovel purchased.

The crushing and auxiliary equipment was furnished by the Austin Manufacturing Company. It consists of a No. 7½ and a No. 5 Austin Gyratory Crusher, a bucket conveyor, a revolving screen, a friction hoist, five end dump rock cars, and the necessary shafting and auxiliaries.

Electricity was chosen as the motive power. A transmission line approximately one and a half miles long was erected. The 3,300 volt line from Marshalltown to Le Grand was tapped and the three-phase 60 cycle A. C. current of 2,300 volts was carried to the quarry, for use in the motors. For illumination at night this current was stepped down to 110 volts.

Slip ring induction motors of 150 and 40 h.p. were purchased—the former to drive the crushers, conveyor, screen and hoist, and the latter to drive a 10x10 Sullivan Air Compressor to supply air pressure for jack hammer drilling. The question of individual drive presented itself, but the increase in the number of motors required for this system would have complicated and delayed delivery, and the idea was discarded.

The crushers are located in an open framed structure 34x42 ft. in ground plan, by 35 ft. in height. The motor house, a "lean-to" 18x34 ft., abuts the crusher house. The bins are 18x32 ft. in plan and about 48 ft. in elevation, having a clearance of 21 ft. 6 ins. beneath, to allow engines and cars to pass. The screen house is located over the bins and is approximately 20 ft. high. From the ridge pole to the ground is about 70 ft.

It is interesting to note that practically all the timber for the plant was furnished by a native timber company, operating just across the Lincoln Highway from the quarry.

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The large motor drives a jack shaft from which power is transmitted to the various machines through a system of belts, chains and gears.

A spur, 1,200 ft. long, with a passing switch of 500 ft. was run in from the M. & St. L. main line. Trackage to provide for 10 loaded and 10 empty cars is provided.

The stripping was accomplished by the shovel, which was at first served by teams and wagons. This proved so unsatisfactory, however, that Koppel and later, Western side dump cars were employed. These were moved by means of a home-made gasoline dinky constructed by the shovel runner. An old Continental motor furnished the power, which was transmitted through a friction drive. This feature was later changed to a positive gear drive.

While some of the stripping was employed to fill around the crusher plant, by far the greatest part was wasted into the pond formed by the former quarrying operations. A trestle work was built out at one end of the lake and as the fill was widened the track moved over.

Preparatory to shooting, the drilling is accomplished by means of an Armstrong Type 25 blast hole driller, which drills a hole 5 ins. in diameter and 23 ft. in depth. The holes are in rows and staggered so as to be about 10 ft. from center line to center line. Enough holes are shot to provide a quantity of rock that can be handled nicely. Some difficulty was encountered at first in shooting because of the seamy nature of the rock, which allowed the charge to shoot out. This was avoided, however, by heavier loading.

In view of the fact that sufficient stripping is done for this year's operation, the shovel is now being used to load the rock. This operation was at first done by hand. The rocks that are too large to be accommodated by the crushers are pushed to one side by the shovel and are jackhamered for subsequent blasting. The small pieces are loaded into the rock cars, which are towed by a team to the foot of the incline leading over the crushers.

Here the hoist cable is attached to the car and the latter pulled up the incline over the crushers. At the top of the incline the end gate of the car is automatically raised and the load is dumped into the No. 1½ crusher. When empty, the car is run down by gravity and another loaded one secured.

This crusher has an hourly capacity of about 125 tons of rock crushed to pass a 3½ in. ring. It discharges into a bucket conveyor, in which the rock is carried to the top of the screen house, where it is discharged into the 48 in.x 20 ft. revolving screen. This screen has 8 ft. of 1-in. perforation and a 5 ft. 6 in. dust jacket with 5/16 in. perforations. The graded rock passes from the screen into the proper bin, while the rejection, that rock too large to pass a 2¾ in. ring, passes over the end of the screen into the rejection chute and thence to the No. 5 crusher for further crushing. This crusher also discharges into the same conveyor as does the No. 7½, so that the rock is once more discharged into the screen for graduation.

The graded rock is loaded in the cars for shipping by gravity through gates in the bottom of the bins.

The rock, although containing some oolitic formation, is in general of very good quality for road-building purposes, having a French coefficient of 8.

While there may have been some doubt at first as to the ability of the plant to produce rock in sufficient quantities for the needs of the paving contractor, this has been dispelled, as the contractor is in no position to handle the entire output of the quarry.

Up to about April 15, when the actual operation of crushing started, the quarry represented an investment of around $80,000. This, of course, includes much labor and operating cost in connection with stripping and drilling, which should be charged against this year's production. Thus far the cost of production has been at a very satisfactory cost per ton.

The screenings—the by-product of the quarry—have several uses. With a total phosphate content of between 84 and 85 per cent, they will be an excellent medium for neutralizing soil acidity. They also have a possibility of being used for road repair work and perhaps surfacing on minor highways.

During construction and operation the plant has been under the supervision of George B. Walker of Denver, Colo. The working force, in addition to the superintendent, while it varies with conditions, consists in general of the shovel crew of three men, the well drill operator, the jackhamer man, the track man, the hoist operator, the blacksmith, the oiler, two men handling the rock cars, and the water boy.

Bunkhouses have been erected on the premises, in which the foremen and workmen live. County Engineer Don C. Elder took very great interest in the erection, installation and operation of the plant. Already the rock crushing plant has prov-

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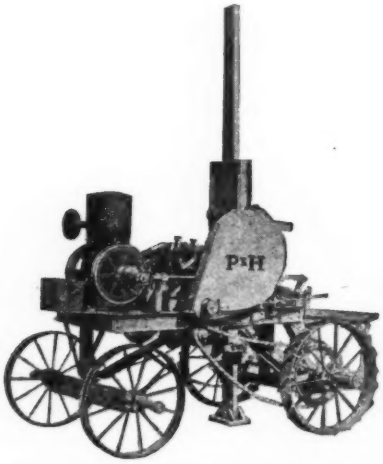
en itself a money saver in reducing the cost of paving to the county. It has restored to activity one of the deserted spots of the country and has made use of home materials for a home enterprise and has established a new home industry that should furnish employment to a large number of men for several years to come, as well as give the county engineer and road officials relief from anxiety as to where their road-building materials are to come from for paving their Primary Road System.

NEW P & H POWER TAMPER

The accompanying illustration shows the latest model P & H Power Traction Tamper made by the Pawling & Harnischfeger Co. of Milwaukee, this new type having a number of improvements over the previous model. All chains and gears are supplied with enclosing guards, the tamper and steering cables used are ⅜ in. in diameter instead of ¼ in., new type traction wheels are furnished, with



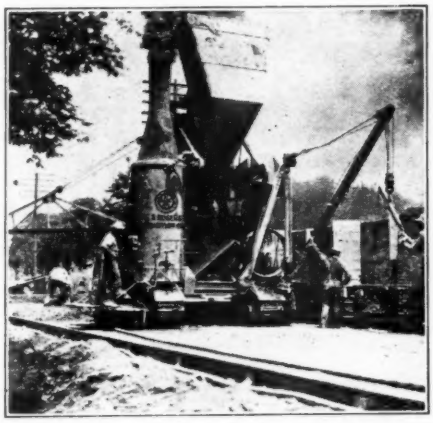
NEW P & H POWER TAMPER.

extension axles to allow for changing the tread from 58 ins. to 76 ins. The standard tamping head is 150 lbs. in weight as before. Other refinements are embodied in the design which makes it an improved machine for speeding up the work of tamping all kinds of ditches and trenches. Only one man is required to operate it—control of the power ram and the forward or backward movement of the tamper being readily accomplished from the operator's seat.

PROPER PLANNING AND COMPETENT SUPERINTENDENCE MEAN GREATER PROFITS ON ROAD CONSTRUCTION

Just how much the production of any equipment can vary, from the handling by one superintendent to that of another, is shown in the following record made by Bates and Rogers, Chicago, on their contract for 17½ miles on the Cleveland-Akron highway.

Work was begun on May 2nd. From that date on for seven weeks the daily



AUSTIN 21-E PAVER AT WORK ON CLEVELAND-AKRON, OHIO, HIGHWAY.

footage increased from low 168 on one day, the first week, to 738 feet in one day of the seventh week; from a daily average the first week, of 295, to daily averages, the following weeks, of 412, 439, 553, 489, 572 and 659. The "low" days were caused by insufficiency of water, as they are dependent upon springs for their supply.

The Austin 21-E Paver had just the same capacity on the first day as it did the succeeding days, but the men were not worked in, the water supply was not dependable, the material was delayed in reaching the paver. But the superintendent on the job is also an engineer, so that all the problems of material, water and coal supply were soon solved, not only for the "next day" with its possible increased production, but for any scale of increased production that they might speed up to. How efficiently he planned his whole schedule from day to day so as to get the maximum out of his equipment is shown in the figures below.

This roadway is reinforced concrete, 18 ft. 4 ins. wide, 8 ins. thick on the sides,

and 10 ins. in the center. A thousand feet of ordinary roads could have been run by such a superintendent at the rate he is working this heavy yardage road.

It is encouraging to manufacturers of equipment, knowing the possibilities of their machines, to see them on jobs that are handled so resultfully.

The following are the daily footages accomplished by Bates & Rogers:

May	1	Sun.	"	8	Sun.	"	15	Sun.	June	1	541
"	2	245	"	9	425	"	16	452	"	2	554
"	3	283	"	10	328	"	17	501	"	3	616
"	4	358	"	11	356	"	18	554	"	4	283
"	5	383	"	12	459	"	19	303	"	5	Sun.
"	6	168	"	13	414	"	20	296	"	6	573
"	7	333	"	14	490	"	21	517	"	7	527
						"	22	Sun.	"	8	622
						"	23	512	"	9	656
						"	24	609	"	10	633
						"	29	Sun.	"	11	425
						"	30	Dec. Day	"	12	Sun.
						"	31	453	"	13	582
						May	25	532	"	14	648
						"	26	673	"	15	738
						"	27	555	"	16	670
						"	28	440			

Contracts Awarded

ROADS AND STREETS

Guide—Contracts Awarded

Ala., Birmingham—Etowah County awarded contract to build part of Gadsden-Birmingham Hwy. from Gadsden to St. Clair Co. line, County will do the work with convicts and regular rdbldg. equipt. at $277,098.56 for the job. Road will have 6-in. slag base with 2-in. surface of asph. conc.

Ala., Camden—Miller & Miller, awarded contract to constr. road bet. Camden and Monroeville, at $91,000.

Ala., Montgomery—Jerry Gwin, Birmingham, Ala., awarded contract to construct Bankhead Hwy. Walker County, at $135,000.

Ark., Little Rock—P. F. Connelly Paving Co. awarded contract for rebldg. and resurfacing roads at Fort Roots, at approx. $250,000.

Cal., Fresno—Geo. S. Benson & Sons, 247 Douglas Bldg., Los Angeles, awarded contracts for grading and graveling 2 stretches of White's Bridge road, Route 1, Sec. C, county hwy. at $101,960 for part 1, and $80,550 for part 2.

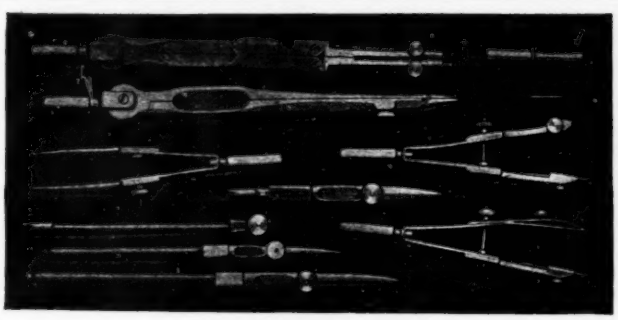
Cal., Fresno—Federal Constr. Co. awarded contract for paving Ventura St. at $73,148; Thompson Bros. contract for paving L St. at $69,654; paving Lucerne Lane at $1,309 and Huntington Blvd. at $14,558.

Cal., Fresno—Contracts for paving county hwys. with asph. conc., Spec. 3, awarded as follows: T. A. Hanrahan, San Francisco, Route 7, Sec. A, Clovis Ave., 4.99 miles, at $102,308; California Constr. Co., San Francisco, Route 11, Sec. B, Elm Ave., 10.13 miles, at $230,658; T. A. Hanrahan, San Francisco, Route 18, Sec. A, Central De Wolf and Wash. Aves., 7.84 miles, at $165,593.

Cal., Los Angeles—Fairchild-Gilmore-Wilton Co., tract for impvt. of Gramercy Pl.—10th St. to Country Club Dr.—at $10,441; Geo. H. Oswald, 366 E. 58th St., award contract for impvt. of Western Ave. —Adams St. to Santa Barbara Ave.—at $93,947.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., awarded contr. at $65,857, for paving portion Norton Ave. (concrete).

Cal., Santa Ana—Fairchild-Gilmore-Wilton Co., Los Angeles Ry. Bldg., Los Angeles, awarded contract for improving 3 miles road in Road Imp. Dist. No. 7 near Placentia, at $55,000; Steele Finley, local, awarded contract for asph. conc. surfacing on La Miracad Ave., Brea-Olinda Rd. Orangethorpe Ave., W. Bway., Grand and Euclid Aves., at $58,261, also contr. for grading and paving with 5-in. asph. concrete certain streets in town of Yorba Linda, at $15,742.



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Cal., Orland—Warren Constr. Co., Journal Bldg., Portland, Ore., awd. contract for paving 25 blocks at $150,000.

Cal., Yuba City—Galbraith & James, Richmond, awarded contracts for paving Cooper tract and Shasta St. ditsricts in town of Yuba City at $112,825 and $17,557, respectively.

Colo., Denver—C. C. Madsen, Denver, awarded contract for grading and drainage of Broadway at $85,715.

D. C., Washington—Cranford Paving Co. awarded contract for approx. $200,000 worth of asph. paving, including new streets and resurfacing. W. F. Brenizer Co. and Geo. B. Mullin Co. awarded contracts for grading number of streets. Comrs. also ordered that more than 100 streets in all sections of District be treated with oil or tar for protection during winter months.

Fla., So. Jacksonville—J. Y. Wilson Co. awarded contract to pave streets at $129,800.

Ida., Boise—Morrison-Knudson Co., Boise., awarded contrs. for construction of 2 sections of hwy. at $70,000.

Ill., Flora—Lincoln Constr. Co., Chicago, awarded contract for 145 miles hard surfaced road at $165,728.40. The 7½ miles bet. Louisville and Flora are included.

Ill., Galesburg—Graham-King Constr. Co., Galesburg, awarded contr. for brick paving at $81,000.

Ill., Joliet—J. C. McCarthy Co., Joliet, awarded contract for asph. paving at $66,000.

Ill., Springfield—Frazier-Davis Constr. Co., St. Louis, awarded contract by State Hwy. Dept. to constr. 8.47 miles Route 15, Sec. 2 and 3, St. Clair-Clinton Cos., at $191,776.

Ill., Springfield—Contracts awarded as follows: Powers-Thompson Constr. Co., Joliet, Ill., 6.71 miles com. rd., at $151,704; Wilson A. Jaicks, 232 E. Pearson, Chicago, Ill., .46 miles com. rd., at $9,925; Cameron-Joyce Co., Keokuk, Ia., 8.68 miles at $160,582; H. K. Rhodes, Lincoln, Ill., 7.86 miles at $148,527; Chas. W. Clark Co., Clinton, Ill., 6.78 miles, at $131,990; Keokuk Quarry Constr. Co., Keokuk, Ia., 4.36 miles, at $99,483.

Ill., Springfield—Frazier-Davis Constr. Co., St. Louis, awarded contract for paving Wascoutah-New Memphis Rd. at $191,776. Road is 47 miles long and lies partly in St. Clair and partly in Clinton Co.

Ill., Springfield—Contracts for highway constr. awarded as follows: Jas. A. Sackley, 133 W. Wash. St., Chicago, 1.44 miles, at $44,574; Ernest Berns & Co., Lombard Bldg., Indianapolis, 6.81 miles at $200,333; grading contracts as follows: Ben F. Harrison, 6117 S. Racine Ave., Chicago, 1.52 miles, $5,345 and 3.17 miles, at $47,689, Trnest Berns & Co., Lombard Bldg., Indianapolis, $27,234; Jas. A. Sackley Co., 133 W. Wash. St., Chicago, contract for impvt. of 1.44 miles, at $44,574.

Ind., Petersburg—Contracts for improving roads awarded as follows: Martin & Zinc, Petersburg, 3 sects. of road at $31,631, $30,518 and $49,823; Frank Elkins, Petersburg, Ind., 4 roads, $43,870, $27,840, $23,950 and $18,460.

Ia., Burlington—Pickens Constr. Co., Burlington, awarded contract for paving Main Street at $65,000.

Tenn., Knoxville—Murray Constr. Co. awarded contract for paving E. 5th Avenue and E. Clinch Ave. at $255,417; Mexican oil asph. conc. with 5-in. base and 2-in. surface.

Kans., Ft. Scott—J. T. Dalton & Son, Junction City, awarded contr. for 7 miles bitum. macadam, at $110,000.

La., Amite—Womack, Kent & Blomyer, Inc., Kentwood, La., awarded contr. for constr. of gravel roads and bridges, 16.2 miles, at $154,512; Peterman & Louistalot, Franklin, La., 15.8 miles, at $152,434.

La., New Orleans—L. Biddle and I. W. Ball, McComb, Miss., awarded contract for constructing gravel road (Opelousas-Marksville Hwy.) 22.35 miles, at $93,611. J. C. Wimberly, New Iberia, awarded contr. for 22.35 miles Opelousas—Marksville Hwy., at $95,984; A. D. Lambert Constr. Co., Rapids Hotel, Alexandria, Ala., awarded contr. for grading and draining 25.42 miles Houma-Morgan Hwy., at $34,189; Harvey and Frith, LeCompte, La., contract for bldg. 4 miles Camp Beuregard-Grant Hwy., $15,270.

Me., Augusta—Contract for constr. of highway awarded as follows: J. Arboric, 82 Church St., New

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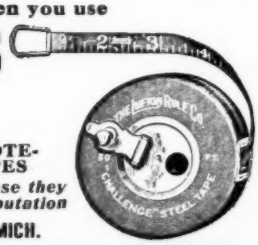

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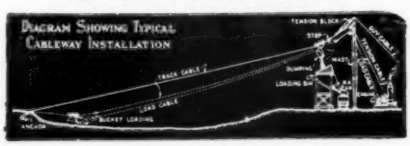

Write for Pamphlet No. 14

SAUERMAN BROS., 1142 Monadnock Bldg. CHICAGO, ILL.

Haven, Conn., 3.64 miles, at $100,403, and 4.93 miles $115,804; bitum. macadam pave; R. H. Newell Co., Uxbridge, Mass., 4.06 miles gravel road at $36,606.

Md., Baltimore—P. Flanigan & Sons, Hartford Rd. & Balt. & O. R. R., awarded contract to pave Edgewood, Grantley, Mt. Holly and other thoroughfares, at $115,780.

Mass., Boston—Hanscom Constr. Co., 70 Kilby St., Boston, contr. for 6,780 ft. bitum. macadam, at $45,941; G. E. Greenough, So. Acton, Mass., 11,000 ft. paving, at $52,330.

Mich., Huron—Beaverton Constr. Co., Beaverton, awarded contr. for constructing 6½ miles gravel road at $75,423.

Mo., Jefferson City—State Hwy. Dept. let following road contracts: (Bolivar) Miller Constr. Co., Springfield, awarded contract at $24,663 to constr. 4.94 miles State Rd. from Bolivar eastward and westward; State Aid Proj. 20.71, Polk Co.; (Boonville) E. C. Johnson, Jefferson City, contr. to constr. 2.51 miles St. Rd. from Bell Air northward and southward, at $10,313; also 16-ft. rein. conc. slab span bridge, at $1,919; (Caruthersville) W. P. Robertson, Caruthersville, awarded contr. at $11,659 to constr. 5.24 miles St. Rd. from Holland northeastward, St. Proj. 20.78; (Harrisonville) M. B. Hess, Nevada, Mo., awarded contr. to constr. 2.38 miles St. Rd. from Archie northward, St. Aid Proj. 20.62, Cass Co. at $8,998.

Mo., Weston—H. Tidd, Hutchinson, Kans., awarded contract for paving various streets at $150,000.

Mont., Helena—Pioneer Constr. Co., Bozeman, awarded contract for constr. of more than 6 miles bitum. macadam hwy., Gallatin Co. near Belgrade, at $188,000.

N. M., Santa Fe—Eight highway contracts which call for constr. of 107 miles crushed rock and gravel surfaced state roads at an aggregate cost of $462,573.01 awarded as follows: No. 1-D, Colfax Co. bet. Cimarron and Colfax, to Atlas Constr. Co. and A. P. Atchison, LaVeta, Colo., 11.59 mi., at $35,866; No. 40, Otero Co., Mescalero to Tularosa, to J. V. Stryker Constr. Co., Denver, Colo., 6.80 mi., at $45,776, also No. 55, Grant Co., Hurley to Ft. Baynard, at $27,925; 4.34 miles; No. 48, Chaves Co., Roswell to Dexter, to Dual, Johnson & Sappington, Roswell, 16.36 miles, at $66,321; No. 54, Hidalgo Co., Steins to Rodeo, to O. C. McGolroth, Mesa, Ariz., 32.60 mi., at $83,823; No. 60-B, San Miguel Co., Tercolote to San Juan, to Peterson, Shirley & Gunther, Omaha, Neb., 20.87 mi. at $121,067; No. 61, Taos Co., Taos to Taos Jct., to Morrison, Sheets & Morrison, Colo. Springs, Colo., 10.06 miles, at $57,669; Forest Aid Co-Operative Proj., Rio Arriba Co. bet. Canjilon to Tierra Amarilla, to French & Harvey, Santa Fe, 4.39 miles, at $24,123.

N. Y., Frankfort—Louisville Asph. Co. awarded contracts for constr. of 4.5 miles rein. conc. on Bardstown Rd. at $161,582; S. M. Billiter, Covington, for 9.5 miles Ky. rock asph. on Midland Trail in Clark, extending from Winchester to Montgomery line, at $352, 899; Geo. T. Miller, Lebanon, Ind., awarded contract for 7 miles rein. conc. on Dixie Hwy. in Madison Co., Richmond north toward Lexington, at $243,287.

N. C., Charlotte—Blythe & Blythe, local awarded contract by Mecklenburg Co. for 3.75 miles road impvt. at $105,000.

N. C., Durham—Murray Constr. Co., Knoxville, Tenn., awarded contr. to construct 60,000 sq. yds. sheet asph. streets, at $300,000.

N. C., Bakersville—Fisher-Carter Constr. Co., Greenville, S. C., awarded contract to constr. 5 mile hard surface road bet. Spruce Pine and Yancey county line, at $140,000.

N. C., Lillington—R. H. Wright, Asheville, awarded contract to grade 13.80 miles State Hwy. in Madison and Yancey Cos., Proj. 557, at $178,328.

N. C., Bobbinsville—Lee J. Smith, Charlotte, N. C., awarded contract to grade 12.98 miles road in Graham Co., at $147,480.

N. C., Statesville—Thompson-Caldwell Constr. Co., awarded contract to construct 7.88 miles road in Iredell Co., from Mecklenburg county line to Shepherd; 5-in. conc. base with Topeka finish, Proj. 587-A, at $241,000.

O., Canton—Following paving contracts awarded: Garaux Bros. Co. Court Ave. & Reynolds Pl. for Camden asph. paving at $138.198; Burd Constr. Co., 1013 Spring Ave., Canton, brk. paving at $34,433.

Pa., Pittsburgh—Contracts awarded as follows: Booth & Flinn, 1942 Forbes St., Pittsburgh, for impvt. of Brownsville Ave., at $200,000; W. O'Herron Co., 1st and McKean Sts., Pittsburgh, contract for paving roadway, West Park, at $9,235; Booth & Flinn Co., for impvts. on Crawford, Mercer and Manella Sts., at $12,492; Thos. Coutts, 3320 Smallman, Pittsburgh, impvt. of road in Lawrence Park, $1,441; Booth & Flinn, awarded contract for repaving Brownsville Ave. to Warrington Ave. and widening of some portions of the thoroughfare at approx. $400,000.

Pa., Philadelphia—Roy B. Warner, awarded contract for road impvts. in vicinity of Overbrook, at $181,500; Ryan Constr. Co. awarded contract to repave 6th St. bet. Vine & Oxford Sts. at $86,000. Pavement will be of redressed granite blk.; Frankfort Ave. repaving job let to Thos. L. Flanagan, at $35,100, also contr. to repave Frankford Ave., Kensington Ave. to Church St., and Kensington Ave., Frankford Ave. to Frankford Crk., at $37,500. Other important contracts approved by Mayor were as follows: Barber Asphalt Paving Co. for repaving Chester Ave., 39th to 59th Sts., at $118,000; Union Paving Co., repaving Girard Ave., Lancaster to 54th Sts., at $57,100; also repaving Lombard, Delaware Ave. to Broad St., at $80,800; Barber Asphalt Co., grading and constructing sheet asph. pavement and other work appurtenant to impvt. of Bensalem branch of Roosevelt Blvd. from Byberry Rd. to Poquessing Crk., at $142,100.

Tex., Comanche—Harris & Powell, Tyler, awarded contract to grade, surface with gravel and constr. draing. structs. on 17.43 miles Hwy. 18, at $129,572.

Tenn., Huntington—W. T. Hadlow awarded contract for grading and surfacing about 10 miles hwy. Marion Co., at $178,589.

Tenn., Memphis—J. R. Paine, in charge, let contract to Unit Constr. Co. and Crinkley Constr. Co. to improve streets at about $500,000.

Tenn., Paris—Little & Dean, Shaw, Miss., awarded contract for bldg. a highway 20 miles in length at $400,000.

Tex., San Augustine—McClung Constr. Co., Cleburne, Tex., awarded contract to grade, construct draing. structs. and surface with gravel 20.97 miles Hwy. No. 1, San Augustine Co., at $231,862.

Va., Hillsville—C. S. Luck & Sons, Richmond, awarded contract to construct 7½ miles bitum. macadam rd., Carroll Co., Galax to Woodlawn, at $150,000; Albert Bros. Kegley, W. Va., awarded contract to construct grading and drainage structs. in Carroll Co., at $160,000.

Va., Orange—Albert Bros., Shawsville, Va., awarded contract to grade and drain 13 miles roadway from Jackson's Ferry to Hillsville, at $160,000.

Va., Portsmouth—City let contr. to R. G. Lassiter & Co. to constr. 12,000 sq. yds. conc. base for sheet asph. pavement, 2,400 sq. yds. one course conc. pavement; will let contr. for 45,000 lin. ft. comb. curb & gutter; total cost, $75,000.

Va., Richmond—Jamison Bros., awarded contract to construct 8.29 miles soil road on State Rd. No. 12 from Five Forks to Patrick Co. line, at $39,607; Hyde & Baxter, awarded contract to constr. 6.5 mi. bitum. macadam road on State Rd. No. 21 bet. Greenwich and Milford Mills, Prince William Co., at $132,244; W. W. Boxley & Co., contr. to construct 3.85 miles 16-ft. conc. road on State Rd. No. 10, no. and west of Farmville, Prince Edward Co., at $101,688.

W. Va., Clarksburg—City let paving and sewering contracts to Paul S. Hornor Co., Clarksburg, at about $80,000; Allen & Rich, Clarksburg, at $7 200; Frank Manilla, Pittsburgh, Pa., at $8,725; Keeley Constr. Co., Clarksburg, at $3,500; to pave 15 city blocks and ¾mi. sewers, approx. $100,000.

W. Va., Huntington—A. Trainer, 2025 4th Ave., Huntington, awarded contract for paving 4th Ave., at $66,146.

Wn., Seattle—Fiorito Bros. awarded contract for paving 2 miles Auburn-Pierce Co. line section of East Valley Hwy. so. from Auburn, at $62,000.

Wn., Vancouver—Colluccio & Erickson, Seattle, awarded contract for paving 8¼ mile section of Pacific Hwy., Woodland to LaCenter, at $325,816.

SEWERAGE AND SEWAGE TREATMENT

Cal., Burbank—I. S. Reynolds, Met. Bldg., Los Angeles, awarded contract at about $35,450 for constructing outfall sewer (vit. pipe) catch basins, etc., for city.

Cal., Los Angeles—Bd. Pub. Wks. awarded contract to B. Derango, at $105,436 for sewer on 52nd St., First Ave. to 7th Ave.; Jno. Artukovich, $2,110, sewer on Hyperion Ave. bet. Fountain Ave. and Effie St., and S. Zarubica, at $61,000 for similar work on 23rd St., Vineyard Ave. to Virginia Rd.

Cal., Los Angeles—S. Zarubica, 3006 6th Ave., Los Angeles, award. contract for constructing cement pipe san. sewers at $61,000; B. Deranog, City, awarded contr. for constr. of sewer in 52nd St., 54th St., Slauson Ave., 1st Ave., 2nd Ave., 3rd Ave., 4th Ave., 5th Ave., 6th Ave., 7th Ave., 8th Ave., 9th Ave., 10th Ave., Angelus Mesa Dr., Victoria Ave., Brynhurst Ave., Chesley Ave., West Blvd. and Hillcrest Dr. at $105,436.

Cal., East San Diego—B. B. Boyd, Box 213, E. San Diego, awarded contract for constructing abt. 30 miles sewer laterals in E. San Diego, at $249,880.

Fla., Tampa—Thompson & Owen awarded contract to construct san. sewer on Beach Drive, at $25,240. Chas. H. Brown, Mayor.

Ill., Chicago—White Construction Co. awarded contract for completing activated sludge plant at Maywood, at $269,768.

Ind., Indianapolis—Bunting Constr. Co., Indianapolis, awarded contract for Thickener Tanks for sewage disposal plant at $24,980; Henry W. Horst Co., Rock Island, Ill., for pumping station, at $121,487.

Ia., St. Ansgar—E. L. Royer, 1155 13th St., Des Moines, awarded contract for furnishing and laying 26,000 lin. ft. 8-in., 3,000 ft. 10-in. and 1,500 ft. 12-in. sewer pipe in various streets at $53,699.

Ia., Sioux City—F. E. West, Sioux City, awarded contract for san. sewer project Hedges Addn., Morningside, $70,000.

Md., Aberdeen—Aiello Constr. Co., Knickerbocker Bldg., Baltimore, Md., awarded contract to construct additions to disposal plant, at $9,800.

Mass., Boston—Timothy Coughlin, awarded contract for sewerage wks. in Peabody St., Roxbury, at $1,349; D. Vitiello, contr. for sewerage works in Bellevue St., Howatt Rd. to Robin St., W. Roxbury, at $11,919.

Minn., New Prague—W. B. Carter, 606 United Bank Bldg., Sioux City, Ia., awarded contract for constructing san. sewer system and garbage disposal plant at $75,000.

Minn., St. Cloud—E. T. Webster, 437 Beacon Ave., St. Paul, awarded contr. for constr. of san. and storm sewer on 10th St., Impvt. Dist. 547, at $39,799.

Mo., Independence—Contracts awarded as follows: constr. of sewer treat. plant, to Ray & Son, Baxter Springs, Kans., at $84,841; ejector stations to Simplex Ejector Co., Chicago, Ill., at $11,360.

Mo., Mexico—Reed & Wheelock, Clay Center, Kans., awarded contr. for constr. of sewage disp. plant, at $24,500.

Mo., St. Louis—Fruin & Colnon Constr. Co., Merchants Laclede Bldg., St. Louis, awarded contract for constr. of sewer at $61,000.

N. J., Palymra—Jno. M. Kelly Co., Camden, awarded contr. for installing sewerage system in town at $93,434.

N. Y., Long Isl. City—Contract for sewers awarded as follows: P. J. Clancy, 460 Lockwood St., Astoria, contr. fo rbldg. sewers in portions of 76th St., at $34,084 and $37,829; Green Contg. Co., 731 Vernon Ave., Astoria, contr. for sewer in Ferguson St., at $122,497.

N. Y., St. George, S. I.—Disposal Equipment Co., 105 Broadway, N. Y. City, awarded contract for bldg. sewage treat. plant and relay pumping sta. at $79,835.

N. C., Asheville—Kelly & Wilson, awarded contract to install sewer and water systems in 100-acre park, at $111,000.

Okla., Stillwater—Municipal Excavator Co., Okla. City, awarded contract for installing 17,000 ft. san. trunk sewer and bldg. new sewage disp. plant (conc.) 50 ft. sq. with depth of 20 ft. Total cost of sewer will be about $50,000.

Pa., Allentown—Geo. H. Hardner, Allentown, Pa., awarded contract for constr. of vitr. brick sewer at $102,065.

Pa., Philadelphia—C. A. Conan, awarded contract for constr. of main sewer on Venango St. bet. present sewer east of Allen and Edgemont Sts., at $55,000. There are 19 other items making up completed list of work. Contracts approximating $150,000 signed by Mayor for sewer work in city.

Pa., Philadelphia—Jos. Perna awarded contract for constr. of main sewer, Wissahickon, low-level intercepting sewer through Fairmount Pk. from present sewer southeast of Greene lane, northwardly toward Gorgas Lane, at $100,000.

S. C., Greenwood—Tucker & Laxton Co., Charlotte, N. C., awarded contr. to construct 10-mile san. sewers with necessary manholes, flood tanks, etc.; Henry Constr. Co., Greenville, contr. to constr. 4 disp. plants. Contr. prices: $51,961 and $22,851, respectively.

Va., Roanoke—Tinsley Constr. Co. awarded contract to extend sewer system, construct 6 to 18-in. pipe line, at $38,000.

Wis., Medford—Jas. Peterson, Medford, awarded contract for sewer construction at $12,400.

WATER SUPPLY AND PURIFICATION

Cal., Los Angeles—Following contracts for water system for town of Lancaster, awarded by county supvrs.: Cast iron pipe and specials, to U. S. Cast Iron Pipe & Fdy. Co., at $12,269; wrought iron pipe and fittings, Mark-Lally Co., at $6,828; gate valves, to Grinnell Co., at $701; 5 hydrants and Jones hydrant valves, to Water Works Supply Co., $880; installation of pipe, trenching and backfilling and material for joints, R. F. Ward, 2126 E. 38th St., at $8,984 (cem. joints); steel tank and tower, Chicago Bridge and Iron Works, at $7,050; constructing pumping plant and derrick, Hull Bros., Box 353, Lancaster, at $1,069, conc. work to same firm at $17 cu. yd. for found. for tank, $20 cu. yd. for found. for pumps and 50c sq. ft. firs.; Turbine pump, Byron Jackson Co., $1,993, booster pump, same company, $1,447; drilling well, complete, including casing, etc., to R. H. Orr, agreed price, $3,350.

Que., Lauzon—R. T. Smith Constr. Co., Ltd., 27 Hillside Ave., Montreal, awarded contract at $53,700 for constr. of filtration plant for waterworks sys., at $300,000; elec. pump to E. Laurie, 243 Bleury St., Montreal.

Que., Montreal—Atlas Constr. Co. awarded contract for erection of electric pumping station at Point St. Charles, in connection with aqueduct impvts. at $498,000; Canada Iron Foundries, Ltd., awarded contract for supply of 400 lengths of 20-in. cast iron pipe and 400 length of 24-in. pipe at $58.50 per ton.

Ga., Elberton—Wood-Rucker Constr. Co., Atlanta, Ga., awarded contr. to construct additions to pumping station; two 500,000-gal. capy. rein. conc. filters 250,000-gal. capy. rein. conc. reservoir and 3,000,000-gal. capy. storage reservoir.

Mont., Browning—Two Miracle Concrete Co., 437 Ford Bldg., Great Falls, Mont., awarded contract for bldg. a 125-ft. steel tower with 75-000-gal. tank, drilled well, pump house and equipt., also laying 5,000 lin. ft. 6-in. cast iron mains. Total cost, $55,000.

N. C., Asheville—Kelly & Wilson, awarded contract to install water and sewer systems in 100-acre park at $111,000.

N. C., Winston-Salem—Hagedon Constr. Co., Manning, S. C., awarded contract to raise dam at reservoir lake 5½ ft.; increase vol. of lake 1,000,000,000 gals.; plans remodeling and installing filters and extending mains; total cost, $50,000.

Okla., Tulsa—Tibbetts & Pleasant, Tulsa, awarded contract for impvts. and extens. to consist of No. 1 pump at $7,000; No. 206 units for filter with equipt. for 4, $56,000; No. 3 Settling Basin, bldg. over gutters, pipe, work, etc., $86,375; total est. cost, $149,373. Contract let at $129,000.

Tex., Abilene—American Cast Iron Pipe Co., Birmingham, Ala., award. contract for pipe line from Lake Abilene to city, at $310,000; O'Connor & McLenlore, Cleburne, Tex., contr. for storage basin at $14,500.

Wis., Cedarburg—Following contracts let on conc. work: Frank Radloff, Plymouth, $12,389; sewers and watermains to Brogan & Schaefer, Green Bay, $91,139; c. i. pipe to Am. Cast Iron Pipe Co., 712 Plymouth Bldg., Minneapolis, at $29,666; tank and tower to Pittsburgh-Des Moines Steel Co., Tuttle & SW 10th, Des Moines, pump, compressors, etc., to Sterling Engnrg. Co., 419 3rd, Milwaukee, at $1,042.

Wis., Milwaukee—H. Hohenzee awarded contract for laying approx. 4,000 ft. water pipe to connect Riverside pumping sta. to Humboldt Ave. tunnel, at $40,877.

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Prospective Work

ROADS AND STREETS

Ala., Anniston—Ord. for paving, guttering and curbing Quintard Ave. from 5th St. on south to 22nd street on north, goes to second reading.

Ala., Athens—Ords. adopted at recent meeting of Council calling for paving all important cross streets in city.

Ala., Mobile—Constr. of a mile of highway along banks of Dog River bet. Alba and Gulf Fishing Clubhouses, authorized by Co. Board of Revenue and Rd. Commrs.

Ark., Fort Smith—Campaign to macadamize Little Rock Rd. for 8½ east of Ft. Smith gaining headway; petitions signed by many residents of twp. and Co. Judge L. Norriss promises help.

Cal., Sacramento—State will expend approx. $1,000,000 for impvt. of approach roads to National Parks. State Hwy. Comn., will repair hwy. bet. Healdsburg and Windsor and will also call for bids for 6 miles hwy. no. of Dixon and for 10 mi. surfacing in Kern Co. Bd. of Supvrs. have agreed to start work on Auburn Blvd. Comn., will soon start work on bldgs. and other impvts. bet. 34th and 35th, R and T Court. Approx. cost, $250,000.

Cal., San Diego—Plans for impvt. work in Kensington Park Dist., east of city limits in Adams Ave. region, accepted. Engr., E. P. Watson, Jr., appointed to supervise work. Resolutions of intention are being prepared. Est. cost, $65,000.

Cal., San Francisco—Bd. Pub. Wks. has ordered paving Columbus Ave. and appropriated $100,000 for the work. Street will be widened bet. Wash. and North Point Sts.

Colo., Colo. Springs—Over $100,000 will be expended in repairing Buttes bridge over Fountain Crk. so. of here and in reconstr. of highway leading to the road. 7 miles of highway on either side of bridge will form part of new fed. aid. project.

Colo., Greeley—Approx. $150,000 in Fed. Aid state funds is to be expended in road and bridge constr. directly so. of here this winter. Work includes bldg. and paving 2 miles trunk line hwy. and 150 ft. steel and conc. bridges. C. J. Schoech, Engr. in charge.

Colo., Denver—Sums of $5,000,000 for this year and $10,000,000 for next year for road constr. within national forests have been approved by Secy. of Agriculture.

D. C., Washington—Chf. Engr., U. S. Bureau Pub. Rds. here has approved plans for 30.9 miles 16-ft. gravel, bitum. and conc. paved road on Austin-Houston (Texas) Hwy. Washington Co., at cost of $925,575; G. A. Bracher, Co. Engr., H. J. Chapell, Co. Judge; also approved proj. statement for constr. of 9.2 miles 16-ft. gravel bitum. rd. on Hwy. No. 20, Kimbro Dist., Travis Co., $249,000; $50,000 F. A. granted. O. Leonard, Engr., Geo. S. Matthews, Co. Judge; also approved plans for constr. of 10-mile 16-ft. gravel road on Hwy. 36-B, Burnet Co., $46,530. Mack B. Hodges, Res. Engr., J. R. Smith, Co. Judge; also plans for constr. of 1.8 miles 14-ft. gravel road on Hwy. 44, cost $87,834; 50% Fed. Aid granted. A. F. Mitchell, Co. Engr.,

Fla., Bradentown—Manatee Co. will build 50 miles of roads east of Manatee and Opeco. $350,000 bonds voted. W. P. Frier, Chrmn. Co. Commrs.

Fla., Jacksonville—City plans to pave various streets with brick or asphalt. Est. cost, $250,000. F. M. Edwards, City Engr.

Fla., Lake Wales—City plans general system of street impvts. consisting of about 200,000 sq. yds. paving at approx. cost of $500,000. B. K. Bullard, Chrm. Council; C. C. Thulberry, Chrm. St. Comn. J. W. Turner, Engr., Lakeland, Fla.

Ga., Claxton—State Hwy. Dept., Atlanta, Ga., will construct 12-mile road in Evans Co. near Reidsville. H. B. Mc.Whorter, Div. Engr., Atlanta, Ga.; 12 miles connecting Buloch Co. with Emanuel and Chandler Co.; 12 miles in Screven Co. from Sylvania to Newington; portion Dixie Hwy.

Ga., Macon—Bibb County will invite bids on paving 3 miles Clinton Rd. and 6 miles Jefferson Rd.; will also pave hill on Thomaston Rd.; 1 mile concrete.

Ga., Savannah—City will pave Dale Ave., Linco'n, Bay, Price and other streets. Thos. Halligan, Clk. of Council.

Ill., E. Moline—Paving and sewer projects to cost $121,518 approved by Bd. Pub. Impvts. Paving contracts will include 38 blks. and cost $106,949; rein. conc., 7 ins. thick with 40 lbs. steel to 100 sq. ft. of pavement.

Ill., Chicago—City plans asph. paving on Marshfield Ave. Est. cost $300,000. C. D. Hill, Chf. Engr. Bd. Local Impvts.

Ill., Herrin—City Council approved of proposed street paving that will involve expendt. of over $1,000,000.

Ind., Indianapolis—City officials will co-operate with Riley Mem. Hosp. Assn. for constr. of park in connection with proposed memorial hospital. Project will involve $250,000. Lake Co. Auto Club, branch of the Hoosier State Auto Club, and State Hwy. Comn. considering hard surfacing Dunes Hwy. from Gary to Mich. City.

Ia., Charles City—County Board of Supvrs. voted to pave road from Rockford to N. Iowa Pike. 6 miles.

Kans., Eldorado—Butler County prepares plans for 10.5 miles bit. road. Est. $250,000. H Austin & Co., Engrs., Eldorado.

Kans., Hutchinson—Lengthy petition presented to City Comn. calling for resurfacing Ave. A east from west line of Main St. to Pershing Ave. with wearing surface of 1½ ins. sheet asph. on one-in. binder course. Material specified in this petition signed by prop. owners, is natural lake asphalt; also street car track space to be paved with bitum. macadam. Petition referred to Commr. of Sts., A. H. Tuttle.

Kans., Topeka—Federal aid totalling more than $150,000 awarded to 8 counties by State Hwy. Comn. on hard surface and road impvt. projs., amounting to more than $1,050,000; Shawnee Co., received $18,000 as fed. aid for grading and culverts on south 6 mi. of Capitol Hwy. Wyandotte Co. received fed. aid award of $18,000 for completing 1½ miles conc. hard surfacing on Parallel road or Fort-to-Fort and Victory Hwys.; Dickinson Co. received award of Fed. Aid in amt. of abt. $6,000, which is to apply with previous award of $53,710 not yet expended in completing the conc. hwy. from Chapman to Geary Co. line. Brown Co. received $20,250 for grading and culvts. on Capitol Hwy. from Fairview 6 miles so. to Jefferson Co. line; Atchison Co., $18,000 for grading and culverts on Atchison-Leavenworth Road; Allen Co., $30,000 for completing additional 2 miles of conc. pavement on the Atlantic and Pacific Hwy. east of LaHarpe; Ottawa Co. received award of $30,000 for paving additional 2 miles conc. rd. on Meridian Hwy. so. of Minneapolis; Franklin Co., $13,950 for grading and culverts on new Santa Fe trail southwest of Ottawa.

La., Monroe—Junior Bd. of Directors of Chamber of Comm. has decided to back City's $2,000,000 paving project. It is believed paving will start by Jan. 1st. 15 or 20 miles of streets will be paved in all sections of city.

Mich., Detroit—City considering paving various streets with concrete. Est. cost, $93,000. C. W. Hubbell, City Engr.

Minn., Minneapolis—Definite steps for financing paving of Superior Blvd., Lyndale Ave. to west city limits, decided on by Hwy. Comm. of Civic & Com. Assn. Harry Gerrish, Chrmn.

Mo., Kansas City—Bd. Public Works plans sheet asph. pavement on 13th St., Grand Ave. to Oak Sts.; asph. conc. pavement on 17th St. bet. Kensington and Elmwood Aves.; bitum. macadam pavement on Terrace St., 73rd to point south of 73rd.

Neb., Sargent—Plans in progress for constr. of hwy. from Kearney through Mason City to Litchfield and towns no. of Bloomfield, terminating in Pierre, S. D. Wm. Lundy, Vice-Pres.

N. Y., Hammondsport—Work on Fed. Aid Rd. from Hammondsport to Branchport will be started this fall. Supvr. Sanford interested in project.

Okla., Beggs—City will construct about 32 blocks asph. conc. pavement. Hughes Engrg. Co., Engrs., 310 Bank of Commerce Bldg., Tulsa, Okla. Roger Willett, Clk.

Okla., McAlester—Beginning at brdg. on Boggy and extending through Farris, Atoka Co., 10 miles to Pushmataha Co. line, modern graded rd. will be built; also stand. bridges and culvts., installed by Atoka Co. Commrs.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Loader and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling and Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill & Ferguson
Howard, J. W
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
McNaughton, David.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Okla., Pawhuska—Osage County will have network of hard surfaced roads within a year if plans of county officials are carried out. More than $750,000 is available for road constr. in county.

Okla., Pryor—Plans under way to pave entire Jefferson Hwy. through Mayes Co., 34 miles.

Okla., Sand Sprgs.—Plans and specfs. will be completed by Holway Engrg. Co., Tulsa, Okla., at once for paving impvts. here. No date set for bids.

Ore., Portland—Street and sewer impvt. work during next 14 months will aggregate $3,245,752, according to figures compiled by Bureau Public Works of Portland. Street impvts. represented in 78 separate jobs that have been approved by city and in petitions submitted by prop. owners requesting pavement of 63 streets. Impvts. ordered or petitions submitted for 40 sewers aggregating $1,610,950. Commr. Barbur intends to push all sewer work thru winter months to relieve unemployment situation. Additional sewer and street work contemplated will reach $250,000.

Ore., Portland—Extension of River Street for dist. of 1 mile approved by City Planning Comn.

Tex., Atlanta—City Council has retained N. H. Roberts, engr., to submit plans and costs for paving streets in business dist. with vitr. brick.

Tex., Crockett—St. Hwy. Dept. has approved plans for constr. of 13.7 miles 29-ft. sand-clay road on Hwy. No. 21, Houston Co., $100,000. G. W. Courter, Cons. Engr. Marlin.

Tex., Dallas—$272,387.02 ordered appropriated out of bond funds for constr. of Garland Rd., by Co. Commrs.' Court. Total cost of hwy., which is abt. 11 miles, will be $480,542.64. Application for state and fed. aid in sum of $205,155.62 has been made.

Tex., Dallas—City considering two paving projects: 9th St.—Willomet St. to Bishop Ave., $63,080, and Preston Rd.—Wycliff St. to 209.7 ft. south of Irving St., $37,873.

Tex., Edinburg—St. Hwy. Dept., Austin, has approved plans for constr. of 33.9 miles 16-ft. gravel road in Hidalgo Co. Will invite bids. P. S. Devine, Co. Engr., Pharr, Tex.

Tex., Houston—Petition for paving Polk Ave. to width of 42 ft. from Main to Milam Streets, granted by City Council. City Engr., requested to prepare plans and specfs. Petition for paving Pease Ave. also granted and specfs. ordered prepared. Paving of Young St. also approved by Council and plans and specfs. ordered drawn.

Tex., Linden—St. Hwy. Dept. has approved plans for constr. of 13.1 miles 12-ft. gravel road in Hwy. No. 1-A. $65,000. Hess and Skinner, Co. Engrs., Southwestern Life Bldg., Dallas; H. D. Nelson, Co. Judge, Linden.

Tex., Mexia—$150,000 bonds voted here recently for purpose of paving alleys and street crossing.

Tex., Odessa—Bids will be asked in October by Ector Co. for constr. of 25 miles of road impvt. B. W. Baker, Co. Engr., Big Springs, Tex.

Tex., Quitman—State Hwy. Dept., Austin, has approved plans for constr. of 4.3 miles 12-ft. gravel road in Wood Co. at cost of $100,000. B. F. Cathey, Co. Engr., Quitman; J. E. Bair, Co., Engr., Mineola.

Tex., San Antonio—$60,000 appropriated from gen. city funds for city's share of cost of resurfacing flood-damaged streets in business section which will cost approx. $250,000.

Tex., Wichita Falls—With the $1,500,000 which county realized from sale of last issue special rd. bonds, it is planned to pave approx. 40 miles additional of county road, repair several others and place conc. culverts and bridges in all roads of county.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Piedmont—Plans for bonding city for sewer work to be undertaken in conjunction with Oakland and for general civic impvts., taken by Bd. of Trustees. Tentative plans call for expendt. of $67,000 for sewer projects; $35,000 for purchase of Piedmont Pk., etc.

Cal., Pomona—City considering constr. of about 25 miles sewer, preliminary to carrying out big paving program. R. F. Goudey, Engr. of State Bd. of Health, has investigated situation and recommended in report to mayor, a new sewage disp. system in which La Verne and Claremont, adjoining towns, should be included. City Engr. Froehde now studying report.

Ont., Dundas—Town Council passed by-law for raising of $45,000 for constr. of trunk sewers and disposal works. John S. Fry, clerk.

Fla., Inverness—City will vote Oct. 25 on $75,000 sewer and water bonds; construct 5 miles of sewers and 5 miles water works.

Ia., Dennison—Resolution adopted to constr. system of main storm sewers, manholes and catch basins: Abt. 334 lin. ft. 12-in., abt. 780 lin. ft. 18-in., abt. 400 lin. ft. 24-in., about 360 lin. ft. 30-in. sewer pipe; 9 catch basins; 12 lin. ft. 18-in., 50 lin. ft. 12-in. sewer runs; 9 street inlets. Jacob Johnson, City Clk.

Kans., Chanute—Ords. passed apportioning cost of constr. of main sewer No. 4 in District No. 4 and for cost of lat. sewers Nos. 401, 402, 403 and 404 in main sewer No. 4. Main sewer, $33,080; lat. 401, $4,916; 402, $4,732; 403, $4,079, and 404, $5,485.

Mass., East Boston—Commr. Sullivan, Dept. Pub. Wks., recommends the extension of sewer in E. Boston to Jeffries Joint, at $1,000,000.

Mich., Negaunee—City has authorized san. engrs. Hoad & Decker, Ann Arbor, to make survey of sewer system and work will soon begin.

Neb., Lincoln—$50,000 storm sewer project in South Lincoln will be built this fall; to extend from 8th and Park Sts. to 14th and Harrison. Districts will include everything so. of South St. from 8th as far east as Sheridan Blvd.

Neb., Omaha—Council approved constr. of sewer thru air field for International Congress here. Aero Club interested. C. F. Bossie, City Clerk.

Okla., Hobart—Prelim. plans prepared by V. V. Long & Co., Cons. Engrs., 1300 Colcord Bldg., Okla. City, for complete sewage disp. plant. Est. cost, $25,000.

Okla., Verden—City will build sewerage system. V. V. Long & Co., Cons. Engrs., 1300 Colcord Bldg., Okla. City.

Ore., Portland—Sewer and street impvt. work during next 14 months will aggregate $3,245,752. Figures compiled by City Bureau Pub. Wks. Impvts. ordered or petitions submitted for 40 sewers aggregating $1,610,950. Commr. Barbour intends to push all sewer work throughout winter months to aid in relieving unemployment. Additional st. and sewer work contemplated will reach $250,000.

Tex., Hearne—City plans establishing system of sewer drainage. C. V. Lornert, San. Engr. State Health Dept., Austin; C. F. Banks, local, will direct work.

Va., Richmond—City—Allen J. Saville, director Pub. Wks.,—will expend approx. $3,000,000 to construct outfall sewer. T. B. Merrick, engr.

W. Va., Princeton—City will construct 1 mile sewer line with 2 lateral branches in west end, up Glady Fork Valley.

W. Va., Welch—Chas. E. Collins, Civ. & Hydr. Engr., Drexel Bldg., Phila., has been retained to prepare plans and superintend constr. of sewerage system to be erected jointly by Spencer and Spencer, State Hospital.

W. Va., Wheeling—Laying of sewer is being planned as 1st civic improvement in Mt. de Chantal dist. City Engr. H. Conrad preparing plans for sewer system.

Wis., Bloomington—Plans under way for 3½ miles sewers, probably septic tank. W. G. Kirchoffer, Madison, Cons. Engr. Vil. Clk. Chas. H. Enke.

Wis., La Crosse—Resolution passed by City Council calling for permission to dredge channel below Isle la Plume, closing Hammond and Dodge chutes, to bring relief to residents on no. and so. side in connection with stagnant sewage pools, Miss. Front Sts. and ft. of Hagar Sts. M. Birnbaum, City Clk.

WATER SUPPLY AND PURIFICATION.

Ark., Conway—City will install iron water mains from reservoir to pumping station at Gleason.

Ark., Horatio—Prelim. steps taken by City Council of Horatio toward forming impvt. dist. for purpose of securing water works and sewer system.

Cal., Fresno—Southern California Edison Co. authorized by State R. R. Comm. to construct an $11,500,000 hydro-elec. plant in Big Creek dist. of Fresno County. Dam will be built in Jan Joaquin river and 5¾ mile tunnel constructed.

Cal., Hemet—Engr. Stetson has submitted to

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Koiesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.
Midwest Engine Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machine Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Council tentative plans for new water system. Drilling of wells in Valle Vista section and constr. of reservoirs is favored. $100,000 bond issue, it is estimated, will be required.

Can., Montreal—City Council considering installing new boilers in Craig Street pumping sta. at cost of $15,000; laying of mains and water services at cost of $42,000. Bids will soon be asked for new pumps costing $15,000 at Rielle St. pumping station for city.

B. C., No. Vancouver—By-law will be submitted to rate payers providing for raising of $50,000 for impvts. of water supply system, including damming of Mosquito Crk. and installation of pumping plant in Lynn Creek. R. F. Archibald, Clk.

Ill., Glen Ellyn—Plans being prepared for laying 4-6 in. water mains in various streets. About $25,000. G. G. Nelson, Surpling Bldg., Elgin, Engr.

Ill., Litchfield—It is planned to build conc. dam, filter plant, 2,000,000-gals. capy., and pumping station. Abt. $175,000. Pearse, Greeley & Hansen, 39 West Adams St., Chicago, Engrs.

La., Crowley—It is proposed to construct complete water works, including machinery, pumping plant, reservoir, mains, etc. L. Noland, Engr.

Mich., Lansing—$100,000 water works bonds voted here.

Mo., Hamilton—City will build water works plant system; $75,000. E. A. Archer & Co., Engrs., 612 New England Bldg., Kans. City, Mo.

Mo., Poplar Bluff—City officials making preparations for plans and specfs. for "harnessing" Keener Springs, no. of here, for city water supply. Springs are largest in the Ozarks and declared to be absolutely pure. Large settling basin will be constructed and water pumped from basin to large standpipe here for distribution. Est. cost of project, $1,000,000.

Mo., Portageville—City considering constr. of water works, including pumps, tower, tanks, pipe line, etc. Approx. cost $400,000. A. C. Moore, Joplin, Engr.

Mo., Sugar Crk.—City will install water works; $90,000 bonds voted.

Mo., Waterville—City considering installation of water mains and constr. of pumping station.

Neb., Ft. Crook—Contemplate extension of water main from Omaha to the Fort. Proposed plans include extra line from so. side thru Bellevue to Ft. Crook. Military authorities interested.

N. J., Rahway—Survey will be made with view to obtaining new source of supply of water for Rahway. Approx. cost bet. $35,000 and $50,000.

L. I., N. Y., Saltaire—Resolution passed at mass meeting that trustees be requested to construct water works in village at cost not to exceed $50,000.

O., Alliance—City and purchase a booster pump and motor for water works. C. E. Barnard, Pres. of Council.

O., Barberton—$450,000 public bond issue for city water service extension to all sections passed by Council.

O., Canton—Safety director has petitioned Council for authority to purchase 30 fire hydrants.

O., Cleveland—Two five-ft. water mains are to be cut thru almost entire length of Rockefeller Pk. and boulevard in connection with new East Side filtr. plant. Water Wks. Commr. Jno. T. Martin has submitted plans to City Planning Comn. Excav. will be started this fall.

Okla., Muskogee—Bryon Kirkpatrick, Tulsa, Okla., and W. B. Collins, Ketchum, Okla., organized $20,000,000 organization; construct water power plant along Grand River.

Okla., Tulsa—City plans to construct dam and reservoir on Spavinaw Crk. and 65 miles pipe line to furnish new water supply. Holway Engineering Co., Civ. & San. Engrs., 332 Atco Bldg., Tulsa. J. D. Trammel Cons. Engr., Ft. Worth.

Pa., Harrisburg—State Dept. of Health, has approved plans for water works system for Cornwell Heights, Bucks Co. and for Lower Twp., Northampton Co.

Pa., Harrisburg—Pub. Serv. Comn. issued order in complaint of Boro of Avalon against Ohio Valley Water Co. in which that company is directed to extend its main, within 30 days, in City View, Avalon, 225 ft. so as to furnish water to consumers who will equip their premises with attic tanks as means of supplementing ordinary pressure in water main.

Pa., Morrisville—Boro, plans constr. of filtr. plan to cost about $72,000.

Pa., Oakmont—Suburban Water Co., contemplates additions to their pumping facilities—total approx. cost $80,000. The J. N. Chester Engrs., Union Bldg., Pittsburgh, Pa.

S. D., Belle Fourche—Bonds voted for $150,000 for water supply; will call for bids for constructing pipe lines from springs on Schmidt ranch in Spearfish Valley:.

S. D., Gregory—City planning to enlarge facilities for more adequate and complete water system.

Tenn., Nashville—Election will be held to vote on $1,800,000 bonds for purpose of improving and extending water works; constructing cast iron force main, booster station, filtration plant; repair cast iron force main, booster station, filtration plant; repair present reservoir, extend water mains; install new boiler and mechanical equip. Paul Treanor, Water Commr.

Tex., Austin—Bonds for city of Dallas in sum of $650,000, approved by Atty. General's Dept. Bonds are for water filtr. plant, $450,000, and incinerator, $200,000. R. V. Tompkins, City Aud., Dallas.

Tex., Bridgeport—Chicago, Rock Island and Pacific Ry. Co., C. A. Morse, Ch. Engr.—Chicago has authorized constr. of pumping sta to supply water for engines, costing $20,000.

Tex., Decatur—City (R. L. Thompson, Clk.) will expend $100,000 to extend water works; install pumps, engines, etc. Henry Exall Elrod Co., Engrs., Dallas.

Tex., Houston Heights—(P. O. Houston) plans expending $23,000 to construct 12-in. main bet. 11th and 19th Sts.; will also construct settling basin at Camp Logan.

Tex., Port Arthur—City will construct water and sewer mains; will vote on $200,000 bonds.

Tex., Stamford—City will complete water works project; voted $125,000 bonds.

Va., South Hill—$150,000 water, sewer and electric bonds voted here.

W. Va., Elkins—City considering constr. of 3-sty. 65x55 ft. filtr. plant, $45,000; two 95x65x14-ft. rein. conc. sedimentation or settling tanks, 275,000 gals. capy. each, costing $40,000; install 2 high pressure, 2 low pressure and 1 wash water pumps, with 2,000,000 gals. daily capy. each; install motors to drive pumps; $9,000; expend $2,200 for intakes, piping, sluice gate, etc.; lay mains on Lincoln Ave. and Railroad Ave. to Central, etc., $14,000; increase reservoir capy. from $750,000 to 1,600,000 gals., $75,000. For detailed information address the mayor.

W. Va., Huntington—City Water Co. will improve water works; lay 8-in. pipe on 12th Ave., from 4th to 6th Sts.; 6-in. pipe on 13th St.—5th to 6th Sts.; also 6, 8 and 12-in. pipe on 8th, 10th, Madison Aves., etc. Also considering installation of settling tank. E. W. Lutes, Supervisor.

W. Va., Mullens—Bids will be opened in about 30 days for installing plant, daily capy. 150,000, constr. of 30x20x16-ft. fireproof bldg. installing 500-G. P. H. air lift and centrif. pump, electrically driven by 2,200 volts, 3-phase, 60-cycle; constr. of 100,000-gal. capy., steel tank. W. Va. Engr. Co., Box 159, Charleston, W. Va.

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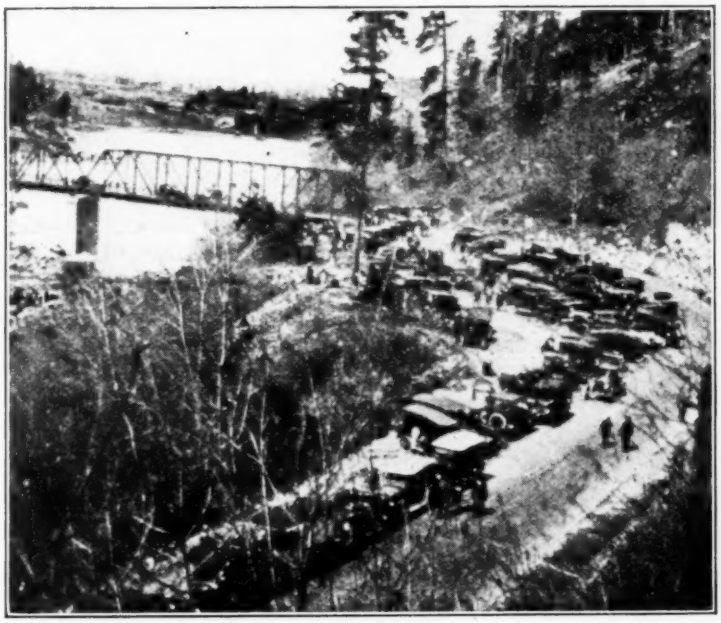

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